Group A

FOIA/PA NO: 2013-0062

RECORDS BEING RELEASED IN PART

The following types of information are being withheld:

Ex. 1: ☐ Records properly classified pursuant to Executive Order 13526
Ex. 2: ☐ Records regarding personnel rules and/or human capital administration
Ex. 3: ☐ Information about the design, manufacture, or utilization of nuclear weapons
☐ Information about the protection or security of reactors and nuclear materials
☐ Contractor proposals not incorporated into a final contract with the NRC
☐ Other _____
Ex. 4: ☐ Proprietary information provided by a submitter to the NRC
☐ Other _____
Ex. 5: ☐ Draft documents or other pre-decisional deliberative documents (D.P. Privilege)
☐ Records prepared by counsel in anticipation of litigation (A.W.P. Privilege)
☐ Privileged communications between counsel and a client (A.C. Privilege)
☐ Other _____
Ex. 6: ☐ Agency employee PII, including SSN, contact information, birthdates, etc.
☑ Third party PII, including names, phone numbers, or other personal information
Ex. 7(A): ☐ Copies of ongoing investigation case files, exhibits, notes, ROI's, etc.
☐ Records that reference or are related to a separate ongoing investigation(s)
Ex. 7(C): ☐ Special Agent or other law enforcement PII
☐ PII of third parties referenced in records compiled for law enforcement purposes
Ex. 7(D): ☐ Witnesses' and Allegers' PII in law enforcement records
☐ Confidential Informant or law enforcement information provided by other entity
Ex. 7(E): ☐ Law Enforcement Technique/Procedure used for criminal investigations
☐ Technique or procedure used for security or prevention of criminal activity
Ex. 7(F): ☐ Information that could aid a terrorist or compromise security

Other/Comments: Outside scope

Sexton, Kimberly

Outside of Scope

From: REYNOLDS, Deirdre [mailto:dmr@nei.org]
Sent: Friday, October 07, 2011 11:35 AM
To: Herr, Linda
Subject: Radiation memo from Luntz

Marv asked that I forward this attachment on to Commissioner Ostendorff as per their discussion.. Have a great day!

Deirdre

nuclear

FOLLOW US ON

luntz global
it's what they hear

To: NEI & Interested Parties
From: Frank Luntz & Lowell Baker
Re: The Language of Radiation
Date: September 13, 2011

We have just completed our first ever all-radiation dial session and identified the specific messages that work – and those that do not – for *all* parties interested in successfully communicating radiation. This research was conducted on behalf of the Nuclear Energy Institute.

We've laid out the specific points you need to follow to create effective, persuasive radiation messaging. This memo provides you with a step-by-step guide to structuring the most effective communications approach, using the right language – and singling out the wrong language – to ease people's fears on radiation.

THE EIGHT KEY FINDINGS YOU ABSOLUTELY NEED TO KNOW

1. **Understand that when it comes to radiation, Americans have *questions*... and assume the worst.** They don't have facts. They assume radiation is bad for their health... and because it is related to something as *personal* as health, the stakes are higher and their guard goes up. All of this leads to an *emotional* reaction. Understanding this is the key to everything that follows in this document. Which leads us to...

2. **You MUST address Americans' emotional concerns before you can do ANYTHING ELSE.** If you don't first express that you *understand* their concerns about radiation, that you *take them and their concerns seriously*, and that *you prioritize their health above all else* (including and especially profit), all of your following messages and educational messages will fall flat. It is all about building trust and credibility.

   We cannot stress this enough. Do not assume that you're getting it right.

   We know that many of you *know* that radiation causes concern... but too little of your language and your tone reflects it. This document is an invitation for you to re-ask yourselves: *are we REALLY meeting people where they are? Are we really emphasizing addressing their emotional concern before – and as much as – we're trying to educate them on the facts?*

3. **More than anything else, this issue is about the *sequencing* of the message.** You must first overcome the emotional concerns that people have about radiation, then you have permission to deliver (almost) all of the factual, logical, and contextual messages you traditionally use.

1800 Diagonal Road, Suite 600, Alexandria, VA 22314
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4. **<u>If you're *dismissive*, you'll be *dismissed* – or worse yet, you'll turn them *against you*.</u>** Too many radiation messages hinge on, essentially, "*why you shouldn't be concerned*" about radiation. If this, <u>alone</u>, is the message, you lose.

   There are two primary reasons. First, it makes the listener feel disrespected, which works against you at a time when you need to be building credibility. Second, it leads the listener to conclude that *you* don't take radiation as seriously as you should. And if you're not taking it seriously, then you're probably "cutting corners" on safety measures to keep the public safe.

5. **<u>Your TONE matters as much as your WORDS.</u>** Because your audience so greatly *personalizes* radiation and health, even your conduct matters. We have tested spokespersons who – literally – laughed away concerns about radiation. Their audience turned against them. To be fair, you might very well receive questions that are scientifically absurd. Even laughable. But that's where your audience is; you have to meet them there, and take every question seriously.

6. **<u>Use simple – but not *simplistic* – examples of radiation in context.</u>** It is the difference between bananas (simplistic) and x-rays (simple). You should – and must – use relatable examples of radiation that people can understand in their daily lives. But examples like bananas seem so trite that they violate the "dismissive" rule.

7. **<u>It's very possible to hit TOO close to home… needlessly. Don't do it.</u>** Don't scare them with overly personalized and previously unknown examples of how they're already getting doses. Facts about how people contact radiation through consumer products (makeup, non-stick pans, irradiated food, etc.) tend to scare people more than they benefit.

   It's one thing to accept the risk from "known" radiation sources that provide benefits that could not be gained *without* radiation (like CT scans and nuclear energy). It's another thing to discover that all these years, consumers have been taking unknown doses of radiation in very personal ways, like cooking with it and ingesting in it. It makes them feel like they *haven't* been getting all the facts, which raises their guard.

8. **<u>Finally – always connect the *specific benefit* of the radiation at issue to the audience. Pivot to the benefit AFTER addressing concerns and providing safety facts.</u>** We want to be clear about this recommendation. We do *NOT* advise you to take on the Quixotic mission of convincing Americans that radiation – overall – has many beneficial uses. (See above re: "beneficial uses" like irradiating food.)

   The better approach is to use specific cost-benefit examples. Once you have alleviated concerns about risks, you must directly reference how *the specific radiation you're discussing* can be used to help the patient, the consumer, or another specific audience.

So, for example:

-- *"We utilize radiation for this CT Scan because it is the least invasive possible way to find out what is going on inside your body. It's the healthiest option available, especially because of all the safety precautions we've discussed."*

-- *"We safely contain radiation inside nuclear facilities so that we can harness its immense benefits for energy production. We know America needs more American-made, cost-efficient, emission-free energy to meet our growing demand. By keeping radiation safely contained, we can deliver that energy to American families."*

-- Rather than titling an informational brochure *"Radiation: Its Effects and Benefits,"* title it *"Radiation: The Facts About What It Is & What It Means For You."*

We recommend THESE approaches to communicating "benefits" because radiation is ALL about *specific* cost-benefit analysis. Americans want to be empowered with the facts so they can decide for themselves if it is worth the risk. There always must be a "benefit" part of that analysis, or you'll never make progress.

SEQUENCING: THE RULES FOR RADIATION MESSAGES

Here is the RIGHT way to sequence radiation messaging: *emotion, tone, safety, facts,* and *cost-benefit.* If you follow this specific order, we give you permission to insert most any fact you wish about radiation within item four:

1. **EMOTION**: You take radiation concerns ***seriously.*** You're NOT here to "teach them why it's no big deal." You're here because you understand *why* they have questions. And you have answers.

2. **TONE:** Your tone is as serious as your listeners' concerns. There's no such thing as a silly question, and you prove that by how you speak and relate to your listener.

3. **SAFETY:** Your number one priority with radiation is to ***safely contain*** it with ***layer upon layer*** of redundant safety systems.

4. **FACTS:** You want to provide information about what exactly radiation is, how much we're talking about here, and to do it in simple, easy to understand terms. Here's how...

5. **COST-BENEFIT:** Your ***responsibility*** is to ***contain*** radiation... **while** harnessing its immense power to provide the energy America needs for a **more energy independent, cost-efficient, emission-free energy** future (or insert other specific benefits from your industry).

Below, we provide you the *specific* language approach for addressing concerns about radiation. These satisfy steps 1 through 3 on the prior page, freeing you to provide educating facts.

Also, the capitalized and underlined words are the most critical words in this entire document. They arise directly from our research and are literally the *best* words for alleviating radiation concerns. Consider them terms of art. They are universally applicable across all radiation-related industries. Organize your messaging around these concepts and you will not go wrong.

WORDS THAT WORK: ADDRESSING CONCERNS

You have the RIGHT TO KNOW the facts about radiation – and those of us who work in industry have a RESPONSIBILITY to deliver them. You have the right to know the facts because Radiation deals directly with your health. It's your body. You decide, based on the facts.

We RESPECT radiation. We take it very seriously, and above all we respect your concerns about it. It's our job to address those concerns, directly, openly, and honestly.

We UNDERSTAND it. Experts and scientists have analyzed it for over 100 years. It's well understood, and every day we are learning even more about how we can harness it and protect against potential harm.

We SAFELY CONTAIN *(strictly supervise/manage)* it with layers upon layers of redundant protections/safety measures.

[As applicable, insert one to three examples of HOW, based on your industry]

We CONTINUOUSLY MONITOR it with extremely sensitive, layered detection systems that detect radiation at the smallest possible levels, to prevent problems before they occur.

[As applicable, insert one to three examples of HOW, based on your industry]

We provide 100% TRANSPARENCY about radiation levels, so independent regulators and you, public [our our patients] can hold us ACCOUNTABLE for how well we are fulfilling our RESPONSIBILITY to keep you safe.

FACTS TO USE... AND LOSE

Below, we provide the best facts – and worst facts – for educating the public about radiation. Rarely do fact-based exercises produce results as clear and compelling as the exercise we conducted in our dial session. The common themes:

-- The more you can talk about the *smallness* of the radiation, the better.

-- The more that facts include examples of how radiation is understood and controlled, the better. AVOID uncertainty at all costs. Do NOT say, "We just can't say for sure."

-- Facts that talk about how they are *already* getting radiation doses in *very personal ways* scare more than they help. Focus on instead on: 1) Facts about *naturally occurring* radiation (like the sun and high altitudes) and 2) Facts about man-made radiation from sources *they already expect and (at least somewhat) are prepared to accept* (like medical procedures and nuclear facilities).

FACTS TO LOSE

- **Most Americans come in regular contact with consumer products manufactured using radiation. For instance, non-stick pans are treated with radiation to ensure the coating sticks to their surface.**

- **Irradiation is used in more than 40 countries, including the U.S., to enhance food safety by killing bacteria, insects and parasites that can cause salmonella, trichinosis, cholera and other food-borne illnesses.**

- **An individual, on average, receives 3 times as much radiation from the many consumer products that contain radioactivity as from nuclear energy.**

- **The amount of radiation contained in a single banana is 10% higher than the amount of radiation a person is exposed to by living within 50 miles of a nuclear facility for a full year.**

FACTS TO USE

- **Radiation from nuclear energy facilities is less than one percent of the amount of radiation we receive from natural sources.**

- **Scientists have studied radiation for more than 100 years and know how to detect, monitor and control even the smallest amounts. In fact, scientists know more about the health effects of radiation than nearly any other physical or chemical agent.**

- **Unlike nature's radiation, the use and handling of man-made radiation is strictly controlled and regulated. Most of the public's exposure to man-made radiation comes from medical applications.**

- **Radiation from nuclear power plants is less than one percent of the amount we receive from natural sources.**

- **A 1990 National Cancer Institute (NCI) study, the broadest study ever conducted and supported by other studies in the United States, Canada, and Europe, found no evidence of any increase in cancer mortality—including childhood leukemia—among residents of 107 counties that host, or are adjacent to, the 62 nuclear facilities in the United States.**

- **If you stood at a nuclear energy facility's boundary 24 hours a day, 7 days a week for an entire year and consumed the local water and food, you would receive less than one-tenth of the radiation exposure you receive from the sun's cosmic rays during a round-trip flight from Los Angeles to Cleveland.**

Finally, to pull it all together, here we've provided you the perfect five minute speech on radiation, incorporating all the lessons learned on sequencing, emotional appeal, and facts.

Following the speech, we provide your go-to checklist of words to use and words to lose.

THE BEST SPEECH ON RADIATION

The issue of radiation is really one of health. Because it's your body, you have the right to know the facts... and we have the responsibility to deliver them – so you can decide for yourself. We believe in 100% transparency so YOU can hold US accountable. We want to put you in control, so you can make the best decision for you and your family based on the all the information available.

We RESPECT radiation and what it can do if we don't take the proper precautions. We also understand why you have concerns and questions about radiation. We have answers.

Radiation can do good things when harnessed properly, but if we're not careful and cautious, it can have potentially serious negative impacts on a person's health. We don't take that for granted.

Keeping you safely protected it is our number one priority. This is NEVER a dollars and cents decision. Your health comes first. If we can't utilize radiation safely, we just can't utilize it at all. Period.

We deeply understand radiation. In fact, it is one of the most understood, researched, and controlled elements in nature. Scientists and experts have studied it for over 100 years.

There is no mystery to it and we can monitor it at extremely low levels – far below levels where it even begins to threaten human health. And while we understand it well today, our industry is always seeking ways to control it more and more.

We take specific steps every day to SAFELY CONTAIN radiation. We use a variety of protections, layer upon layer, to keep radiation where it belongs: four-feet thick containment domes with steel reinforcements at nuclear energy facilities; lead vests and clothing to keep medical personnel and patients safe during diagnostic testing; and constant oversight and enforcement by expert scientists whose sole priority is safety, and who are empowered to hold us accountable.

We CONSTANTLY MONITOR radiation so that there are no surprises. Our technology is extremely sophisticated and is continually becoming more so. We are constantly evaluating radiation levels, in our facilities and in our communities, to prevent problems before they even occur. And we make sure we're thorough: we test air, water, soil, food, buildings, and people.

THE BEST SPEECH ON RADIATION (CONTINUED)

I'd also like to share with you some FACTS about radiation as it occurs in nature... some real-world, understandable context for how much radiation we're talking about here. Radiation occurs naturally in many substances, coming from sources ranging from the sun to granite to potassium. It's a part of nature and, in small doses, is not a health threat.

Even as we know we have to keep you safe from radiation, we also know that the benefits of nuclear technology are too immense to pass up.

Nuclear technologies are used in 1 out of every 3 medical and diagnostic tests every year, and patients are protected from the negative impacts of radiation while benefiting from non-invasive procedures. It's a net benefit to their health.

Nuclear energy harnesses radiation to one-fifth of the electricity that drives our economy, providing cost-efficient and clean energy to meet our nation's growing demands.

If we harness the benefits of nuclear technology while aggressively controlling the risks, American families will have more choices, and better health, at lower costs.

Above all, we are committed to providing 100% transparency about radiation levels, so independent regulators and you, the public [or our patients] can hold us accountable for how well we are fulfilling our responsibility to keep you safe and healthy... benefiting from the positive uses of radiation while preventing all potential harms.

Words to Use...	*Words to Lose...*
Safely Contained	Channeled
Controlled	Governed
Managed	Watched Over
Fully Understood	Directed
Strictly Supervised/Regulated	Overseen/Handled
Safely	Relentlessly
Constantly/Continually	Rigorously
Expertly	Aggressively
Professionally	Vigorously

Franovich, Mike

From: BUTLER, John [jcb@nei.org]
Sent: Thursday, October 11, 2012 12:42 PM
To: Franovich, Mike
Subject: Re: Industry GSI-191 Presentation Materials, October 9, 2012

Mike

Thank you.

John

Sent from my iPhone

On Oct 11, 2012, at 12:28 PM, "Franovich, Mike" <Mike.Franovich@nrc.gov> wrote:

> John,
>
> Thanks for the info! I would share the info with Pat Castleman (KLS) and Nan Gilles (GEA). Commissioner Magwood is currently without a reactor TA. Rebecca Tadesse (WDM Materials TA) is filling in. E-mail addresses below.
>
> patrick.castleman@nrc.gov
> nanette.gilles@nrc.gov
> rebecca.tadesse@nrc.gov
>
> *Mike Franovich*
> *Technical Assistant for Reactors*
> *Office of NRC Commissioner Ostendorff*
> *301-415-1800*
>
> **From:** BUTLER, John [mailto:jcb@nei.org]
> **Sent:** Wednesday, October 10, 2012 5:48 PM
> **To:** Franovich, Mike
> **Subject:** Industry GSI-191 Presentation Materials, October 9, 2012
>
> Mike,
>
> Attached, for your information, are the materials used during yesterday's drop in with the Chairman. Can you reply back with the email addresses for Reactor TAs that you believe would have an interest in receiving this.
>
> John
>
> John C. Butler
> Senior Director, Engineering and Operations Support

Nuclear Energy Institute
1776 I Street NW, Suite 400
Washington, DC 20006
www.nei.org

P: 202-739-8108
F: 202-533-0113
M: (b)(6)
E: jcp@nei.org

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Industry Actions and Response to GSI-191

October 9, 2012

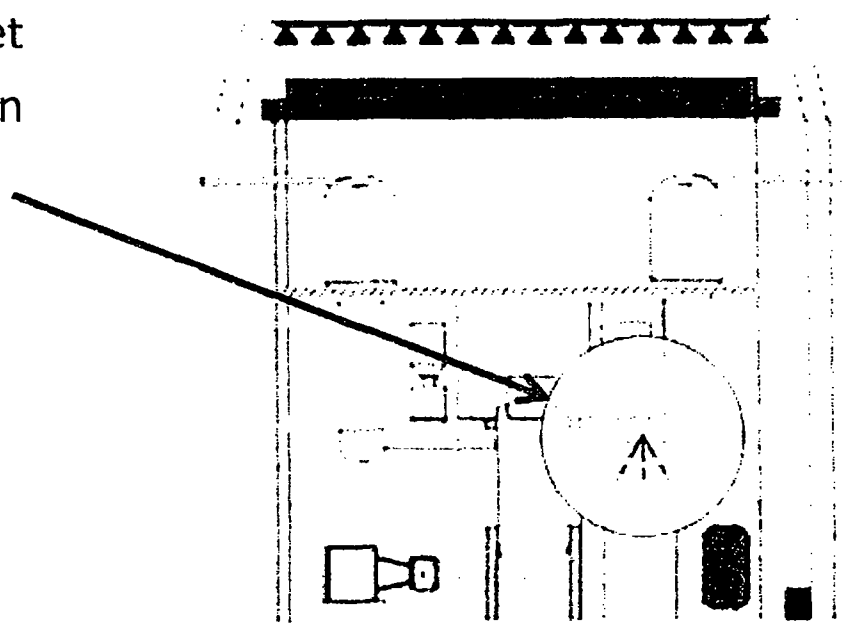
Major Points

1. Plants are safe now with the actions that have been taken to mitigate the consequences of Loss of Coolant Accident (LOCA) generated debris
2. Evolving technical issues have resulted in extended resolution time for in-vessel effects
3. Conservative treatment of complex phenomenology under deterministic framework leads to unrealistic treatment
4. The net effect has been that current test results (25/15 grams of fiber per fuel assembly) are very conservative and very restrictive
5. Technical questions remain regarding the current test results (e.g., ACRS Thermal Hydraulic Phenomena Subcommittee questions)
6. More work is needed to definitively resolve technical issues AND support the appropriate success criteria; e.g., maintain long term core cooling (LTCC)
7. The goal of the Pressurized Water Reactor Owners Group (PWROG) in-vessel evaluation program is to establish what is necessary to maintain LTCC. The program is consistent with and supports the closure options identified in SECY 12-0093
   - Schedules for plant specific resolution and PWROG program schedule need to be aligned

Pressurized Water Reactor
Loss of Coolant Accident

Phase 1 – Break Initiation to End of Blowdown

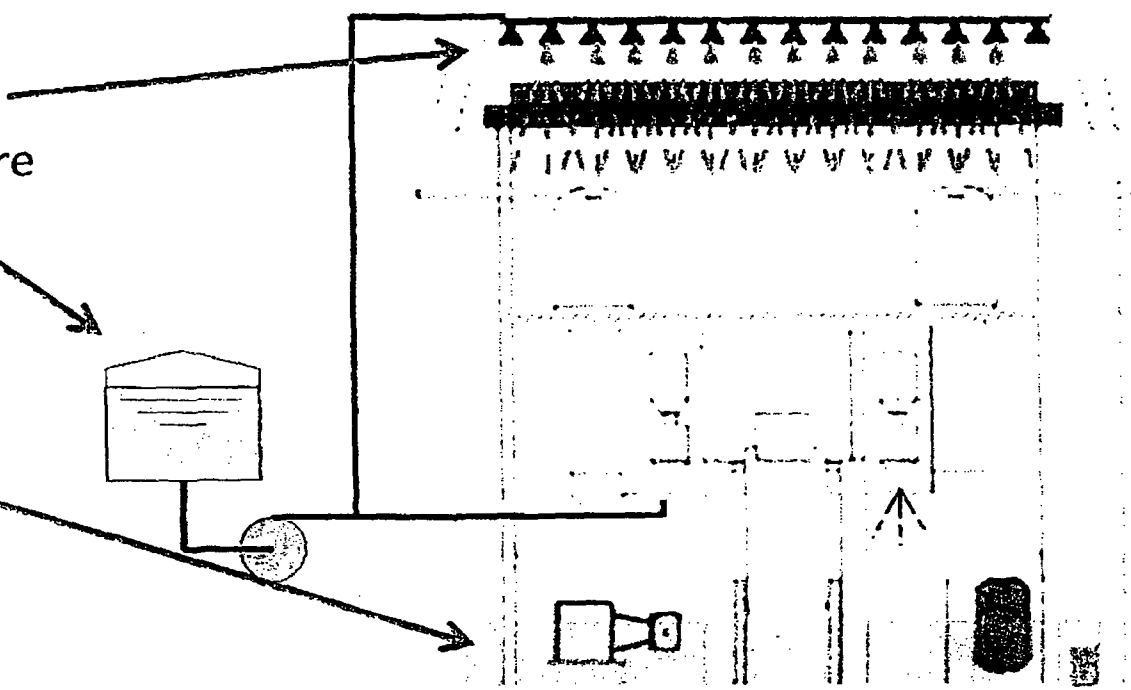
- Time Period – 0 seconds to ~25 seconds for limiting break
- Reactor Coolant System blowdown as quasi steady jet
- Impulse loading on insulation materials and coatings
- Debris generation



Pressurized Water Reactor
Loss of Coolant Accident

Phase 2 – End of blowdown to End of Injection (Start of Recirculation)

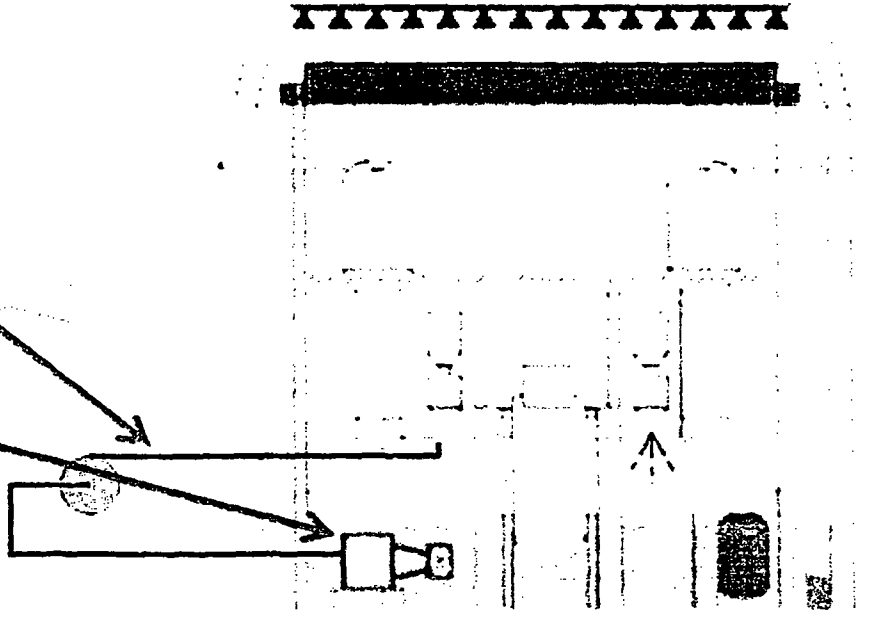
- Time period 25 seconds to 1800 seconds for limiting break
- Containment spray injection to reduce containment pressure
- Injection to reactor coolant system from storage tanks
- Pool forms in lower containment



Pressurized Water Reactor
Loss of Coolant Accident

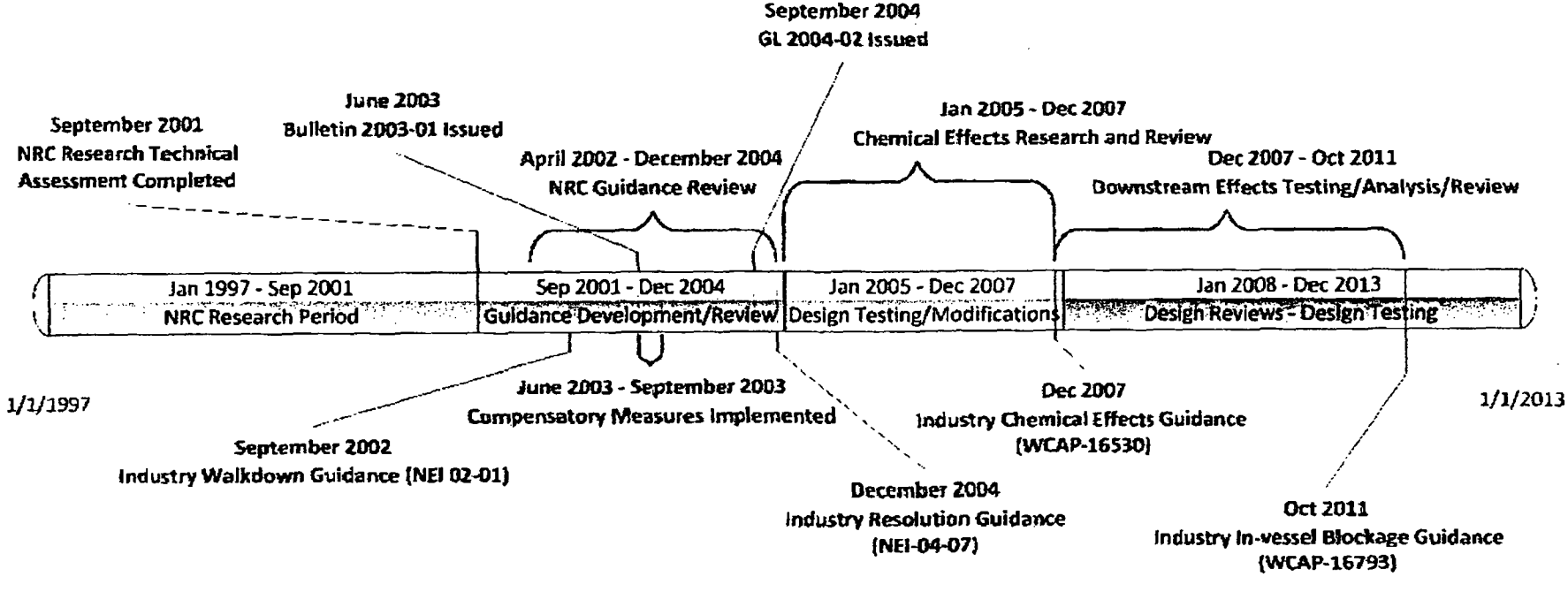
Phase 3 – Recirculation

- Time Period - >1800 seconds
- Long term recirculation/cooling path established
- Strainers in lower containment prevent debris from entering recirculation pathway
- GSI-191 is focused on providing assurance that long term cooling is maintained to the reactor core.



GSI-191 Timeline

- GSI-191 activities can be divided into four distinct phases
  - NRC Research Period
  - Guidance Development/Review
  - Design Testing/Modification
  - Design Reviews – Design Testing



GSI-191 Timeline

- **NRC Research Period**
  - GSI-191 was opened as a generic issue following completion of NRC Research on potential for blockage of PWR strainers
- **Guidance Development/Review** Sep 2001 - Dec 2004 Guidance Development/Review
  - All PWRs implemented compensatory measures shortly following opening of GSI-191
  - Industry developed guidance for assessment of debris generation and transport needed for assessment of new strainer designs
  - Industry guidance and generic letter (GL) 2004-02 issued in late 2004
- **Design Testing/Modification** Jan 2005 - Dec 2007 Design Testing/Modification
  - Plants began modifying plant design in response to GL 2004-02
  - Chemical effects research was conducted in parallel
  - Results from research required a new round of testing and plant modification
- **Design Review – Design Testing**
  - Scope of issues to be addressed continued to expand (in-vessel downstream effects, boric acid precipitation
  - Guidance for resolution continued to evolve
  - The acceptability of acknowledged conservatisms in methods became challenging when combined with conservative treatment of new issues

Refer to Attachment 1 for expanded discussion of timeline

Refer to Attachment 2 for expanded discussion of conservative treatment

GSI-191 Conservatism

- Regulations applicable to GSI-191 (10CFR50.46) require that uncertainties be accounted for so that there is a high level of probability that acceptance criteria would not be exceeded
- This requirement has been met for GSI-191 through conservative treatment of individual phenomena and actions at each phase of the postulated event
- However, conservative treatment of new phenomena combined with conservative treatment of original GSI-191 concerns has resulted in overly restrictive limits
  - The large level of conservatism used in treatment of debris generation, debris transport and strainer testing were accommodated by large strainers
  - Conservative treatment of chemical effects was added without reassessing the level of conservatism for debris generation, debris transport and strainer testing
  - In-vessel effects testing was performed in bounding manner, using conservative treatment of chemical effects, debris generation, debris transport and strainer testing

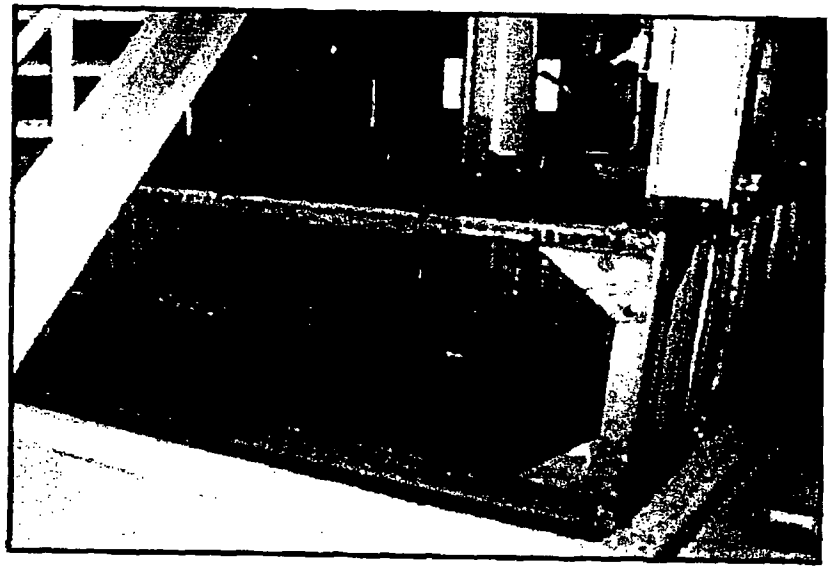
Plants are Safe Now

- All U.S. PWRs have taken numerous actions to improve safety and reliability of Emergency Core Cooling System (ECCS) recirculation systems
  - Every PWR has increased the size of their recirculation strainers by orders of magnitude
  - Potential debris sources have been reduced or eliminated
  - Targeted insulation replacements, reduced aluminum sources, and improved containment cleanliness
  - Compensatory measures, including improved procedures and operator training, have been implemented
- Commission conclusions in December 2010 Staff Requirements Memorandum remain valid:

"While they have not fully resolved this issue, the measures taken thus far in response to the sump-clogging issue have contributed greatly to the safety of U.S. nuclear power plants. Given the vastly enlarged advanced strainers installed, compensatory measures already taken, and the low probability of challenging pipe breaks, adequate defense-in-depth is currently being maintained."

Example of Expanded Strainer Capacity

Previous – 85 ft2



Current – 4854 ft2

Refer to Attachment 3 for additional examples of plant modifications

Summary of Plant Changes

- Design Modifications
  - Containment sump replacements
    - Replaced with advanced design strainers
    - On average, size increased by factor of 32
  - Replacement of fibrous insulation with reflective metal insulation
  - Removal of problematic insulation and unqualified materials
  - Modified flow paths within containment to enhance settling/debris capture
  - Added debris interceptor devices/bypass eliminators
  - Replaced/modified coated surfaces
  - Reduced exposed metal surfaces
  - Changed chemical buffers to reduce impact of chemical precipitates
  - Replaced/modified components downstream of strainers to avoid debris impacts

Summary of Plant Changes

- Process Modifications
  - Enhanced procedures and training for operator recognition and response to debris blockage
  - Improved containment cleanliness programs
  - Improved control of materials to be used/installed in containment
  - Increased level in refueling water storage tanks and implemented procedures for quicker refill
  - Improved configuration control of insulation in containment
  - Increased rigor of containment inspections

Current State

- Issue closure using deterministic methods has been challenging
- Despite challenges, most PWRs have addressed all GSI-191 issues except for in-vessel effects
  - Approximately 3/4 of PWRs have resolved all issues except for in-vessel effects
  - Approximately 1/4 of PWRs are faced with significant impacts to meet deterministic limits
    - Necessitates use of risk-informed methods to appropriately guide resolution actions or significant insulation removal

Current State

- No plants have closed the in-vessel effects issue
- Current test results are excessively restrictive for practical operational use
  - 25/15 gm of fiber per fuel assembly
  - Difficult to apply current test result as operational limit; assumed latent debris loads present a problem
  - Test result is a consequence of attempts to conservatively address (bound) full range of individual phenomena, processes, scenarios and designs in deterministic framework
- Approximately 50% of the PWR Fleet can not close the in-vessel effects issue based on current test results

Going Forward

- **Industry continues to believe it is important that GSI-191 be resolved in a manner that provides a stable resolution**
- The industry course of action for resolving GSI-191 was provided to NRC in a May 4, 2012 NEI letter
  - The plan establishes a defined set of actions that is based on the degree of current reliance on fibrous insulation in containment
  - Chief Nuclear Officer (CNO) alignment
- In accordance with the plan, each PWR licensee will provide a docketed submittal by December 31, 2012, that identifies a resolution path and schedule
- This plan is consistent with options outlined in SECY 12-0093

Industry Action Plan

- **Resolution for Low Fiber Plants**
  - A capability exists today to resolve GSI-191 using conservative deterministic acceptance criteria (current in-vessel limit – Option 1 or Option 2 Deterministic)
- **Resolution for Medium Fiber Plants**
  - Additional testing is needed to establish reasonable acceptance criteria for in-vessel effects (ongoing PWROG test program – Option 2 Deterministic)
- **Resolution for High Fiber Plants**
  - A risk-informed resolution (Option 2 Risk-Informed or Option 3) will be used to identify, in a structured manner, the plant changes necessary to address GSI-191

PWROG Program Plan

- Previous efforts (WCAP-16793-NP, Revision 2) involved 67 tests, over $4M of PWROG funding, and yielded a very bounding 25/15 g/FA result that most plants cannot support
- ACRS questions on test results (25/15 g/FA) need to be answered
  - Requires additional testing and analysis/evaluation
- Future-looking program developed to address these two needs, incorporating an independent third-party review (I3PR) of previous testing to inform future testing

PWROG Program Plan

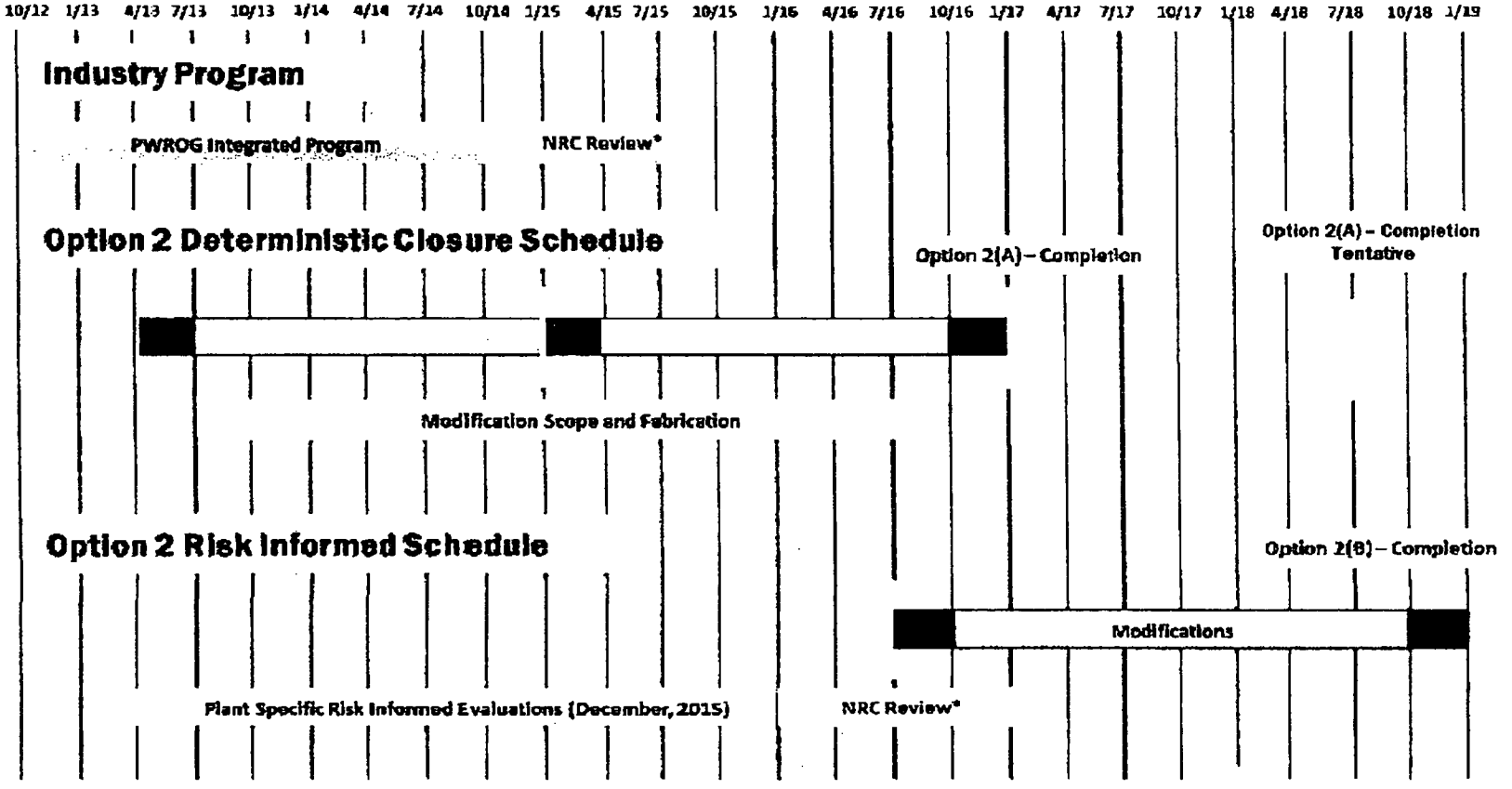
- New PWROG Test Program includes a comprehensive in-vessel closure plan that will include formal testing protocols
  - Development of success criteria
  - Development of Phenomenon Identification and Ranking Table (PIRT)
  - Fuel Assembly Testing and Report
- Boric acid precipitation testing is being included in test program
- Topical reports on in-vessel and boric acid precipitation programs to be submitted Summer 2014

PWROG Program Plan

Schedule

- SECY suggests an Option 2 (deterministic) schedule of three refueling outages after 12/31/2012 for plant resolution of GSI-191
- PWROG programs' submittals are Summer 2014, with SE's 12-18 months later
- Plants ideally need 2 refueling outages post-SE to identify insulation to be replaced and to design, order, receive, and install the replacement insulation
- Adjustment to SECY (or extensions to various plants) may be necessary to allow 2 outages post-SE (especially plants with 2013 outages and 18-mo cycles)
- In addition, some plants initially pursuing Option 1 may find it necessary to switch to Option 2 - Deterministic should their strainer bypass test results fail to get NRC approval

PWROG Program Plan
Draft Schedule



Summary and Conclusions

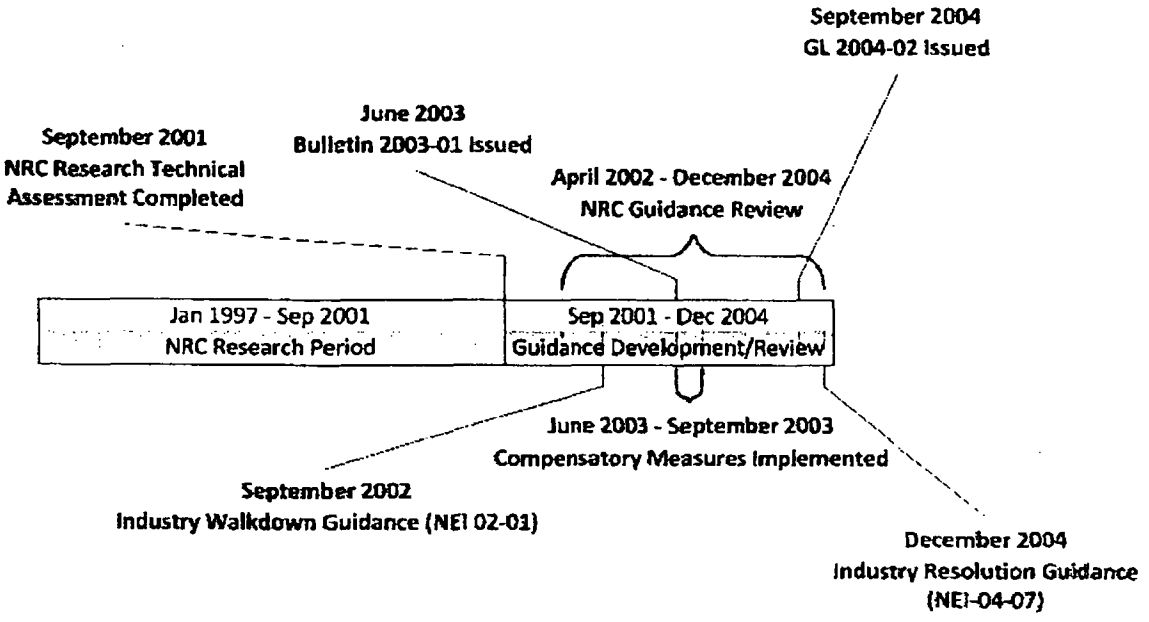
- Significant improvements have been made and plants are safe today
- Industry closure under current restrictive limits requires recognition of conservatisms
- Comprehensive test program being executed
- Schedule flexibility must be considered given the program uncertainties

Attachment 1

GSI-191 Timeline

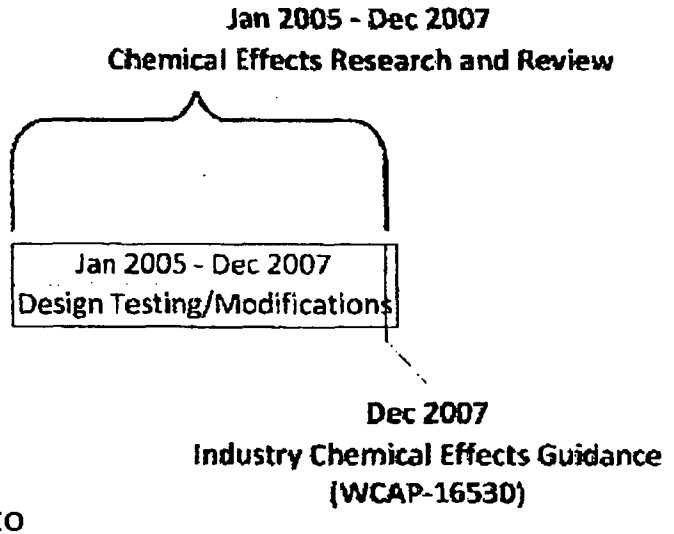
GSI-191 Beginning

- Strainer Blockage concerns were first evaluated in 1980s as Unresolved Safety Issue A-43
  - The issue was resolved through the issuance of revised guidance
  - Risks were viewed to be low and no plants were required to modify their designs



- NRC initiated additional research in the 1990's
  - This research concluded that regulatory action was needed to ensure that PWR designs addressed the potential for debris blockage following a design basis event
  - The concerns with potential strainer blockage by debris were addressed under generic safety issue (GSI) -191
- NRC generic communications were issued to all PWR operators
  - Bulletin 2003-01 required PWRs to implement compensatory measures
  - Generic Letter 2004-02 required PWRs to perform detailed analyses and to modify their ECCS designs as appropriate
- Industry developed guidance to address the impact on strainer performance of break generated debris and begin actions to address GSI-191 concerns

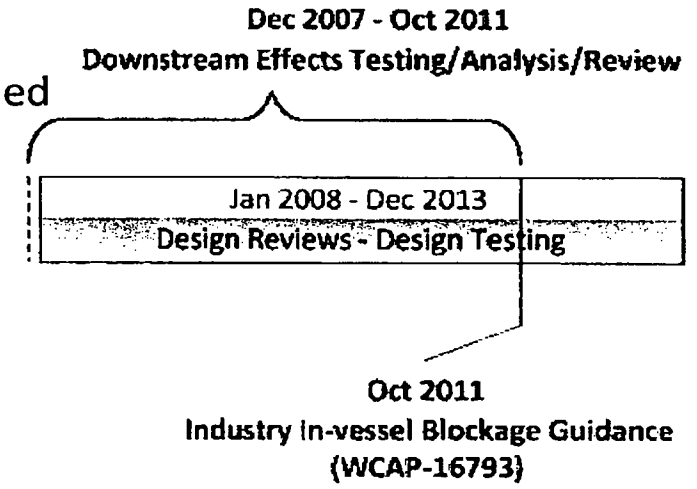
GSI-191 Industry Response



- All PWRs modified their plant designs to address concerns with debris blockage
  - Installed significantly larger strainers with smaller openings
  - Removed specific debris sources
  - Removed, replaced, or remediated insulation in containment
  - Modified flow paths to ensure adequate water supply to strainer
  - Modified components in downstream flow paths
- Design efforts were supported by plant-specific testing
  - Jet Impingement Testing of Containment Materials
  - Debris Material Transport Testing
  - Debris Material Erosion Testing
  - Coatings Adhesion and Leaching Testing
  - Strainer Head Loss Testing
- During this time period, research on potential for chemical effects was conducted
  - Results from this research became available after testing and plant modifications were completed
- The inclusion of chemical effects forced a new round of testing and plant modification

GSI-191 Industry Response (Part 2)

- During this time period the scope of issues continued to incrementally expand
  - Chemical effects, downstream effects, boric acid precipitation
- Guidance for resolution continued to evolve
- Addressing new issues and guidance required additional testing and analysis



- Total industry effort to resolve GSI-191 has been substantial
  - ~$25M to $30M spent per unit to resolve (based on 2008 data)
  - Expended significant dose for modifications and walkdowns
- The acceptability of acknowledged conservatisms in analysis methods became challenging when combined with conservative treatment of new issues
- Resolution efforts were further challenged by overly conservative treatment through testing of in-vessel effects

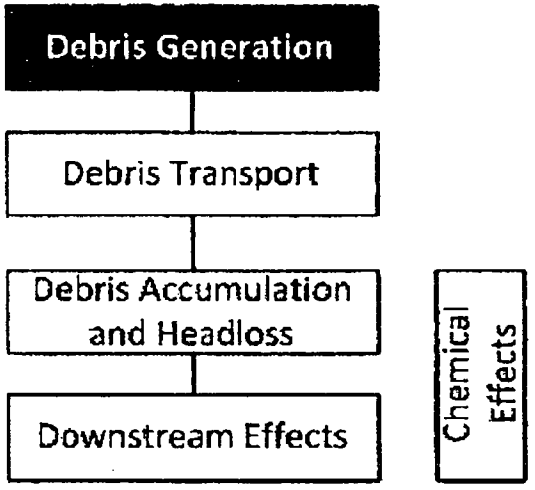
Attachment 2

GSI-191 Conservatism

Debris Generation Conservatism

- **BREAK SIZE AND LOCATION:** The limiting break is controlled by a unique combination of break size and location that make it highly improbable.
  - The likelihood of a large rupture in PWR coolant piping is less than $1x10^{-5}$ per year.
  - Estimates for the frequency of a full double-ended rupture of the main coolant piping are on the order of $1x10^{-8}$per year.
  - Smaller piping ruptures, while still unlikely, provide a better measure of expected behavior and present a more benign challenge to ECCS performance.

ECCS Recirculation Performance Event Phases



- **BREAK CHARACTERISTICS:** Break opening time is assumed to be instantaneous.
  - The non-physical assumption of an instantaneous opening of a break leads to a significant overestimation of the debris generation potential for a postulated break.
  - Even conservative estimates of minimum break opening times for large bore piping preclude formation of damaging pressure waves.
  - The wide recognition that a large RCS pipe is more likely to leak and be detected by the plant's leakage monitoring systems long before cracks grow to unstable sizes is referred to as leak-before-break (LBB) and is an accepted part of regulatory compliance with General Design Criterion (GDC) 4 for most, if not all, PWRs.

Debris Generation Conservatism

- **ZONE OF INFLUENCE (ZOI):** A non-prototypic spherical zone of influence is used to maximize the affected volume surrounding the postulated break.
  - The zone of destruction around a break will generally be focused in a single direction, significantly limiting the "zone" of materials subjected to break forces.
- Full destruction of materials within a conservatively determined spherical ZOI is assumed
  - Results based on unjacketed insulation are applied to stainless steel jacketed insulation
  - Insulation is presumed to have a limiting seam orientation relative to the break.

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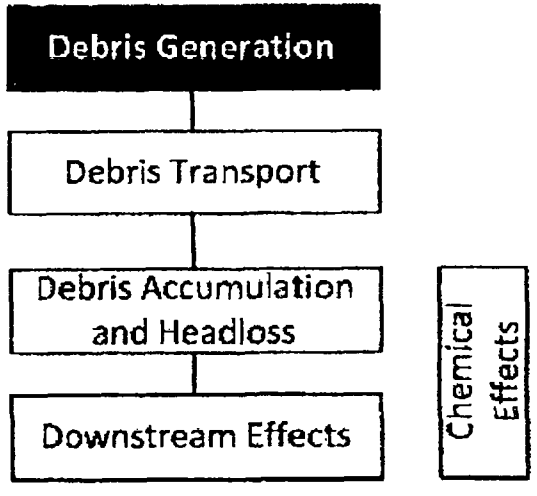

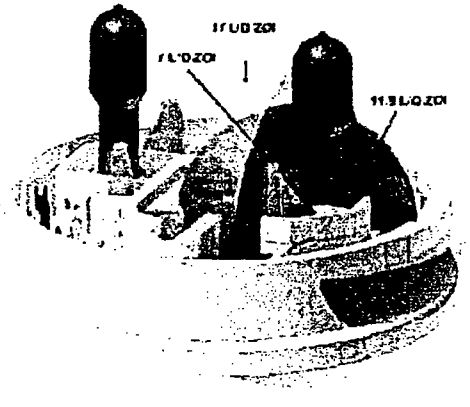

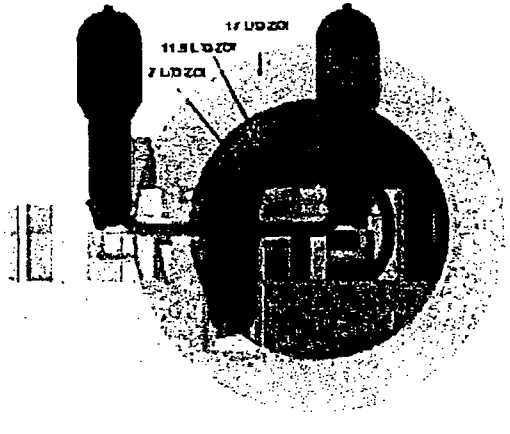

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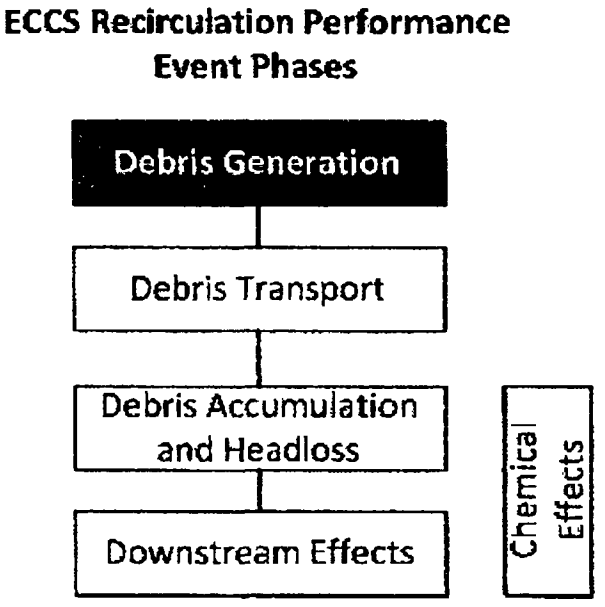
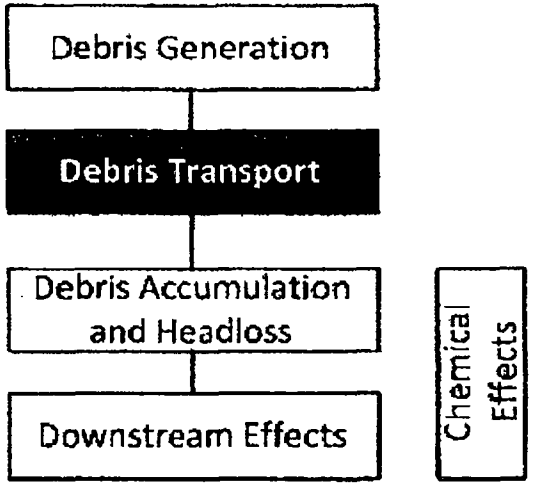


- **DEBRIS CHARACTERISTICS:** The test that generates the highest percentage of fines is used as the basis for the fiber small fines fraction.
- This size distribution applies over the entire ZOI, neglecting the reduction in small fines fraction with increasing distance from the break
- The debris size distribution of insulation debris caused by high energy pipe rupture will consist mostly of large pieces
- Most large pieces will not transport to the screen, hence the debris loads on the strainer will be significantly smaller than current analyses predict.

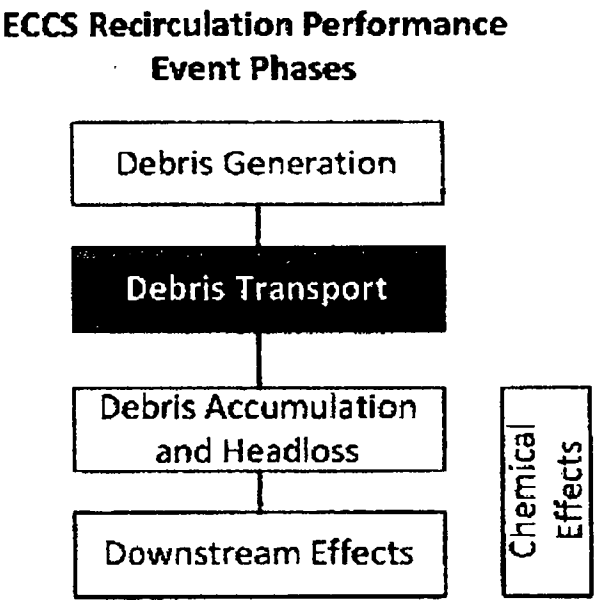
Debris Transport Conservatism

ECCS Recirculation Performance Event Phases



- All fine debris is assumed to wash down to the sump pool elevation with no holdup on structures.
  - Although fine debris would be easily carried by draining spray flow, a significant quantity of fines would likely be retained on walls and structures above the containment pool due to incomplete spray coverage and hold up on structures. Even in areas that are directly impacted by sprays, some amount of fines would agglomerate together and not transport
- Recirculation flow does not begin until 30 minutes or later into an event. Until this occurs, there is a relatively quiescent period during which significant settling will occur. Such settling is ignored.
  - Debris present or generated at the beginning of the event will generally be pushed by break and spray flows into quiescent regions and will reside as debris piles. At the start of recirculation, it would take substantially higher flow rate to cause movement of these piles of debris. Even if these piles of debris were to move, there are numerous obstacles (supports, equipment, curbs, etc.) that would prevent debris from reaching the strainers.

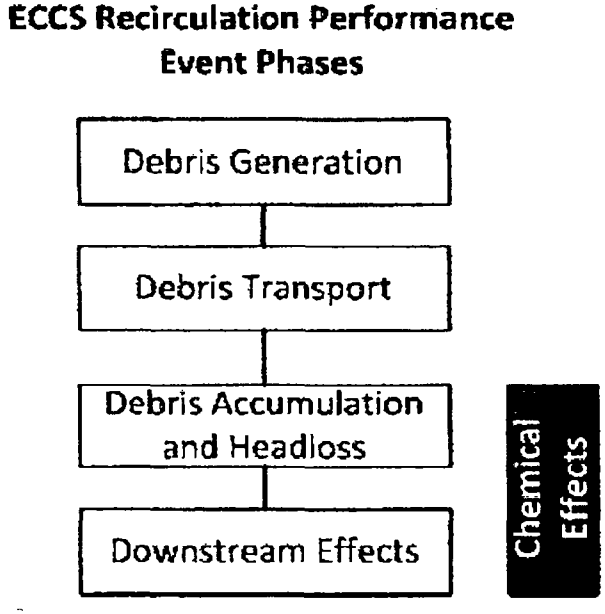
Debris Transport Conservatism



- Credit for inactive pool regions of containment is limited to 15%.
  - In a prototypical plant, substantially more than 15% of the fine debris would transport to the inactive sump regions where it could not affect sump performance
- An unusually high erosion percentage is assumed for non-transportable sizes of fiberglass insulation.
  - Testing shows that fibers do not "erode" under the low flow conditions present in PWR containments.
- Prescribed NRC guidance calls for uniform debris transport to and deposition on the strainer surfaces.
  - Testing shows that debris transport to the surface of complex strainers will not be uniform, unless it is artificially induced in the testing. Some settling and uneven debris distribution is prototypical. This results in significantly lower head loss across the strainers.

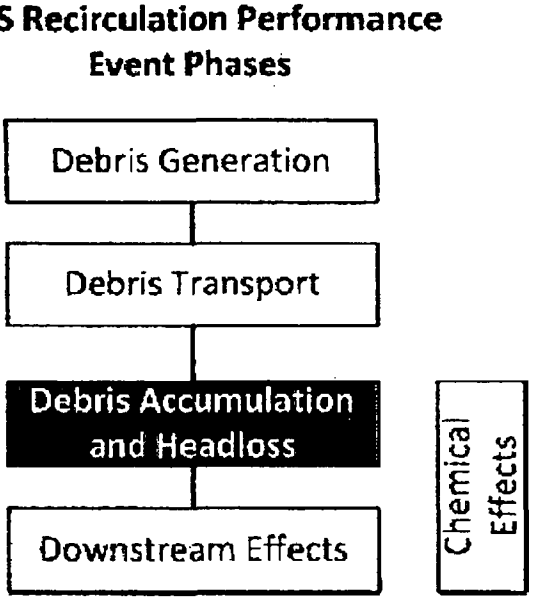
Chemical Effects Conservatism

- NRC accepted chemical effects modeling (WCAP-16530) relies largely upon short term corrosion rates (hours) for the determination of long term releases (30 days)
  - Long term release rates of constituent materials are expected to be one to two orders of magnitude lower than that predicted by design basis models due to surface passivation and formation of surface films.



- 100% of chemical species of interest are assumed to precipitate. These precipitates are further typically assumed to be present at the beginning of the event when flow margins are at a minimum
  - When solubility limits are taken into account, the predicted precipitation is reduced by 1-2 orders of magnitude. Further, precipitates will form during periods when flow margins are greater
- The current models call for chemical precipitate formation in a form readily transported to the sump screen.
  - A significant portion of precipitate formation will occur on the large surface areas in containment and will not be readily transported to the strainer

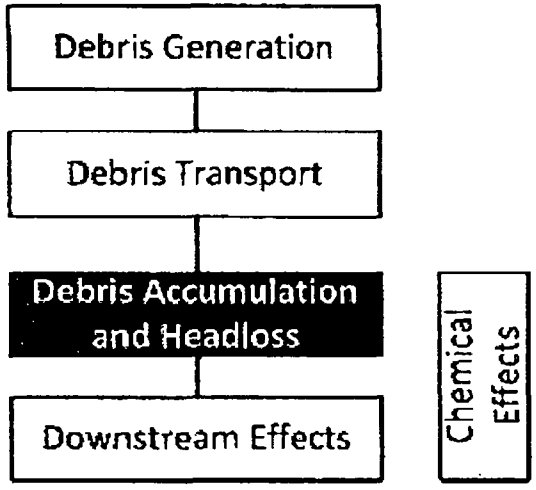
Debris Accumulation and Headloss Conservatism



- During strainer testing, the full particulate load is introduced to the test tank/flume first, followed by fiber fines and finally small and large fiber pieces. This debris introduction sequence is non-prototypical and results in the highest strainer head loss
  - During a design basis accident, particulate debris, fiber fines, and larger fibrous debris are expected to reach the strainer at approximately the same time resulting in lower headloss across the debris bed
- Fiber fines produced by erosion are assumed to arrive at the strainer at time t = 0, instead of hours or days later when flow margin is greater
  - Fiber fines created by erosion will arrive at the strainer over a period of hours or even days. A significant portion of these fines will arrive after flow margin has increased to the point where additional strainer headloss can be readily accommodated
- A full 30-day chemical precipitate load is assumed to arrive at the strainer at the earliest possible time with no credit for settling or nucleation on containment surfaces.
  - The quantity of precipitate arriving at the strainer surface is expected to be significantly lower that tested amounts. In addition the precipitate is expected to arrive gradually and resultant headloss would be compensated by increased headloss margins

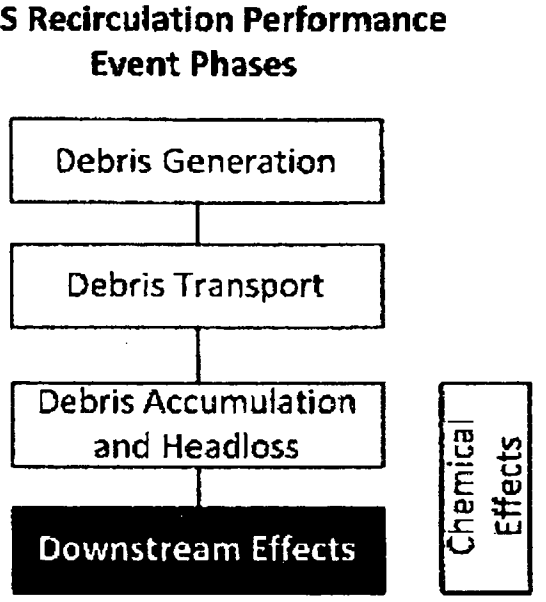
Debris Accumulation and Headloss Conservatism

ECCS Recirculation Performance Event Phases



- During testing, all fiber and particulate debris is collected on the strainer prior to addition of chemical precipitates.
  - The chemical precipitate coating on the strainer would be less uniform than that achieved during testing since some fiber and particulate debris would arrive along with the precipitates, producing a less uniform deposit. A less uniform coating would yield a lower strainer headloss.
- During headloss testing, repeated attempts are made to get debris that has settled in the immediate vicinity of the strainer back onto the strainer
  - The conservatism of debris transport calculations is clearly demonstrated in testing where non-prototypic "mixing" must be employed to prevent natural settling of debris. Much of the debris that is predicted to transport to the strainer will settle in the immediate vicinity of the strainer and not become part of the strainer debris bed.

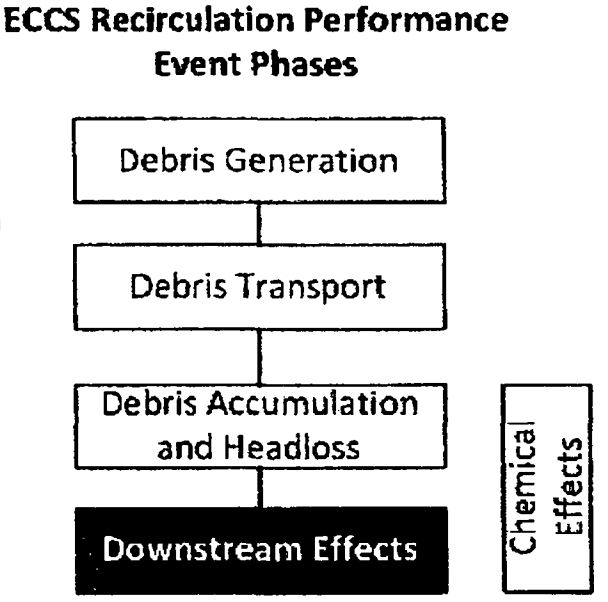
Downstream Effects Conservatism



- Testing performed at ambient temperature
  - Testing performed at prototypic temperatures would result in lower head loss → higher debris limit
- Testing performed at high flow rate – bounds all PWRs
  - Testing at plant specific flow rate would result in less head loss →higher debris limit
- Testing performed using single assembly – ignores non-uniformity of flow/power conditions across core
  - Full core representation in core would demonstrate significantly higher effective debris limit
- Testing performed using early introduction of conservative chemical effects surrogate
  - Use and introduction of chemical precipitate that is representative of plant conditions would reduce head loss → higher debris limit
- Testing performed in closed loop resulting in 100% capture
  - Full representation of mechanisms for bypass and settling of debris would raise effective debris limit
- Testing sequenced debris materials to produce limiting head loss
  - Particulates, fibers and chemical precipitates were introduced in non-prototypic manner to bound worst case conditions

Downstream Effects Conservatism

- Test limit established based on worst case fiber to particulate ratio
  - Lower head loss → higher debris limit would result from expected particulate/fiber ratio
- Testing ignored disruptive flow behavior present in heated core bundles
  - Local flow blockages from fiber will lead to local boiling that will act to disrupt the blockage and reestablish cooling flow



- Testing ignores alternate flow paths present in every PWR
  - Alternate flow paths will provide cooling flow to the core even if the core inlet is blocked
- Testing evaluates debris conditions under collapsed temporal conditions (i.e., Liming conditions early in event, combined with limiting conditions late in event)
  - Testing under expected conditions would likely demonstrate no adverse flow blockage for any PWR

Conservatisms in In-vessel Debris Testing

- By letter dated July 20, 2012, Pressurized Water Reactor Owners Group (PWROG) submitted a supplement to topical report documenting the conservatisms associated with the in-vessel debris testing (WCAP-16793)
- The purpose of the supplement was to facilitate future operability determinations pursuant to emergent conditions for the low fiber plants
- NRC staff elected not to include the supplement in their review of WCAP-16793
- NRC acknowledgement of the conservatisms would have strengthened the position of a low fiber plant pursuing Option 1 of SECY 12-0093 as their means of closure

Attachment 2

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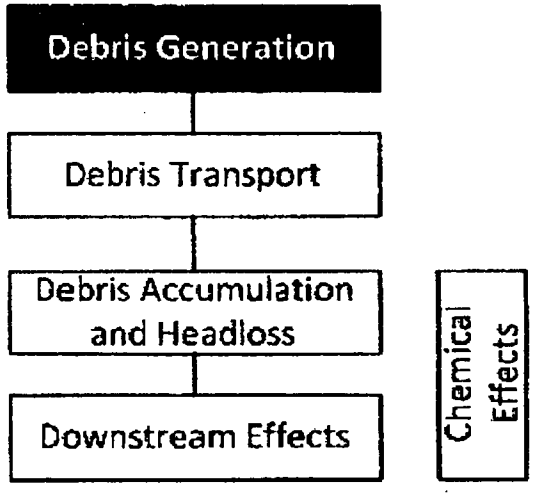

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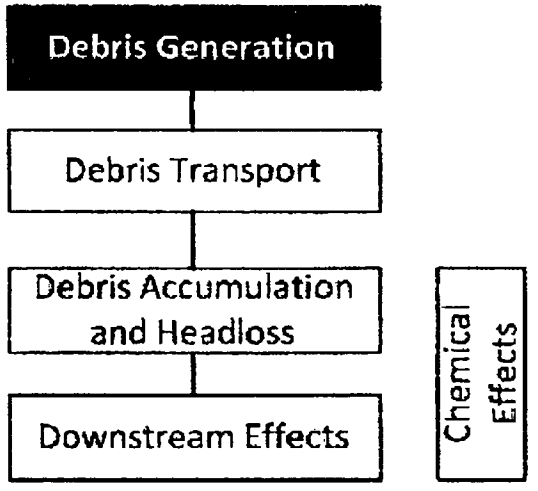

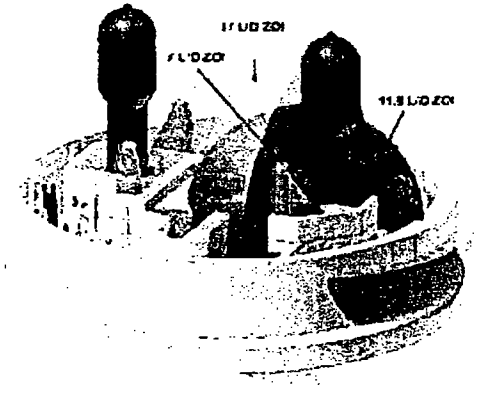

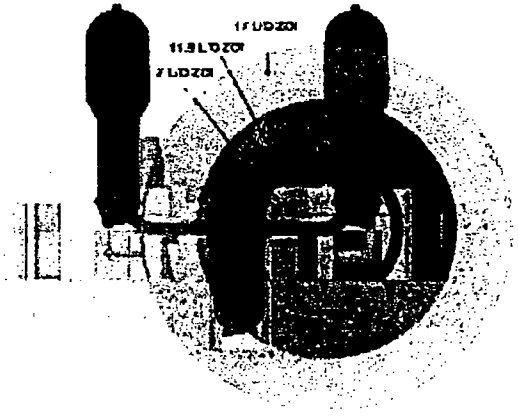

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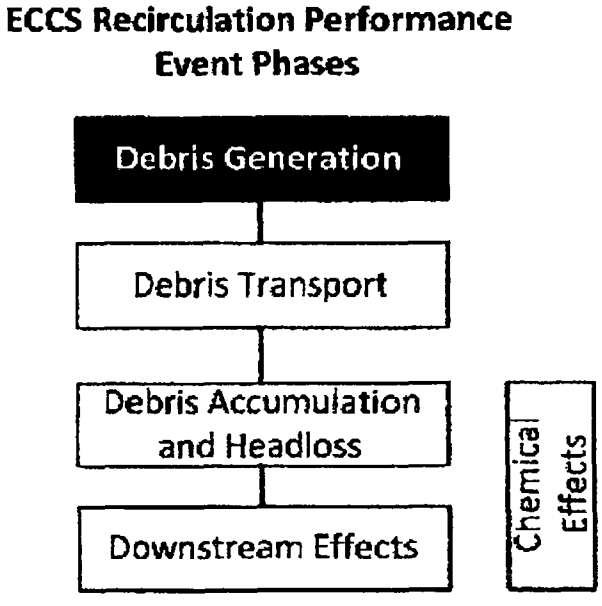

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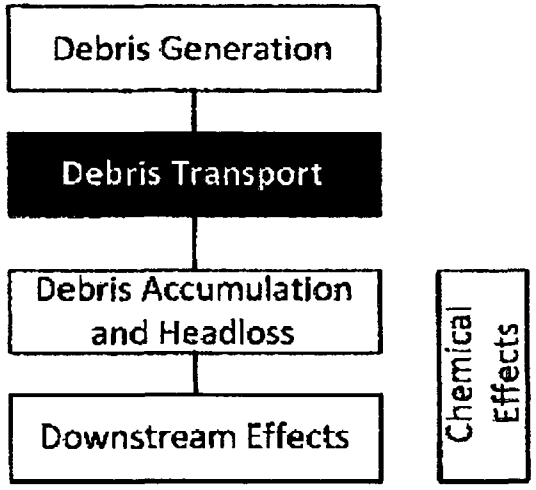

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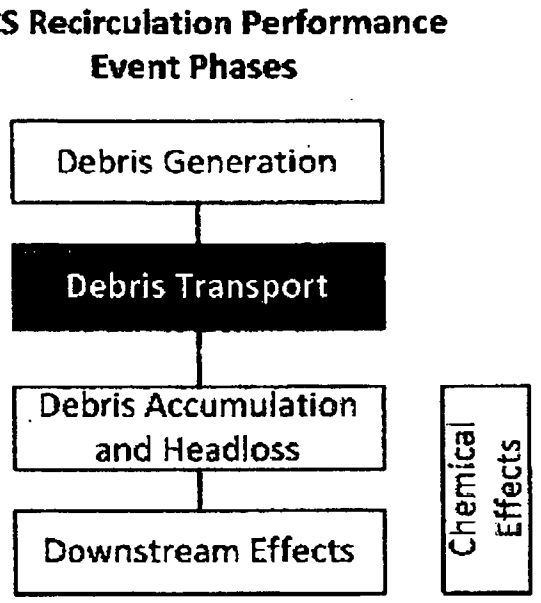

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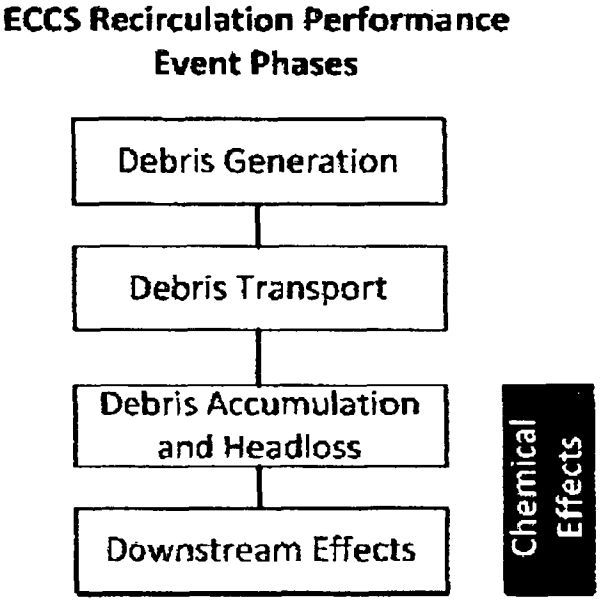

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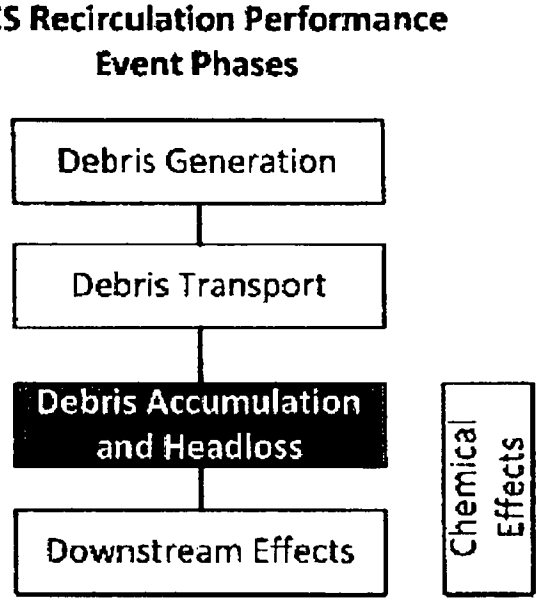

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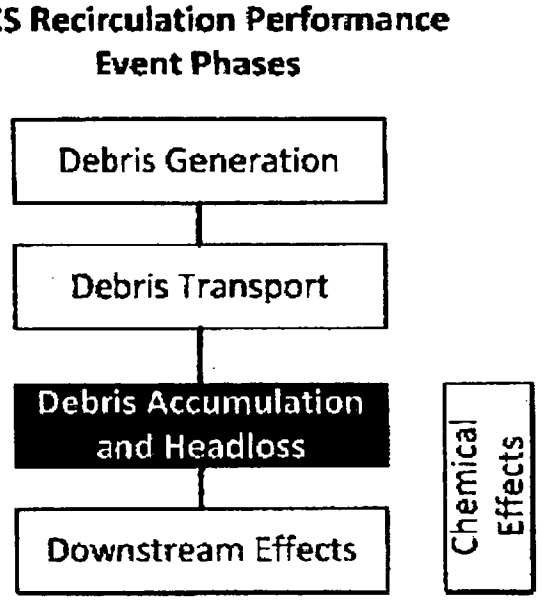

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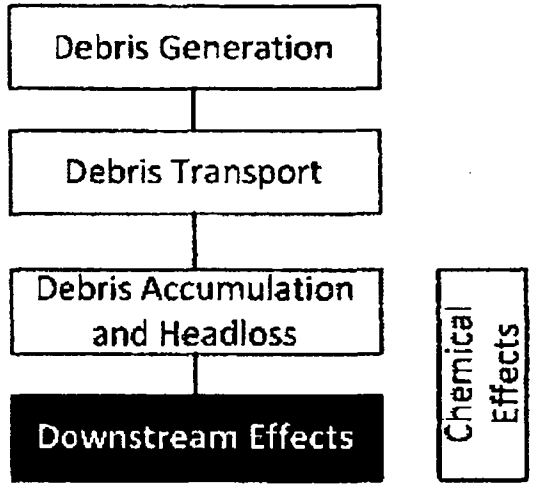
Downstream Effects Conservatism

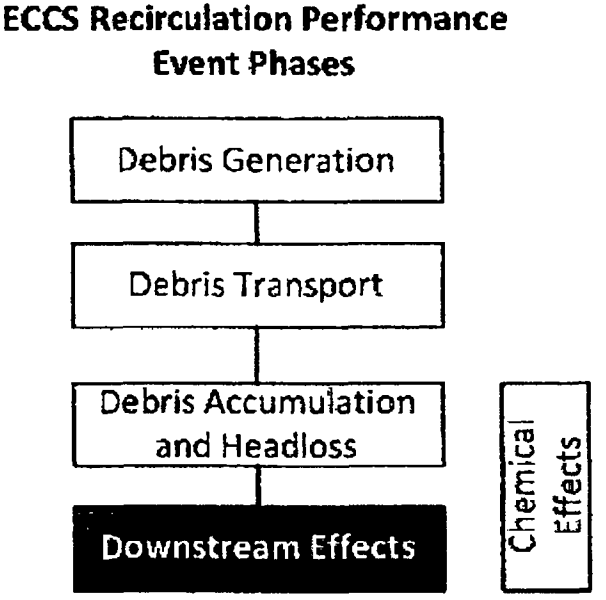
ECCS Recirculation Performance Event Phases



- Testing performed at ambient temperature
  - Testing performed at prototypic temperatures would result in lower head loss → higher debris limit
- Testing performed at high flow rate – bounds all PWRs
  - Testing at plant specific flow rate would result in less head loss →higher debris limit
- Testing performed using single assembly – ignores non-uniformity of flow/power conditions across core
  - Full core representation in core would demonstrate significantly higher effective debris limit
- Testing performed using early introduction of conservative chemical effects surrogate
  - Use and introduction of chemical precipitate that is representative of plant conditions would reduce head loss → higher debris limit
- Testing performed in closed loop resulting in 100% capture
  - Full representation of mechanisms for bypass and settling of debris would raise effective debris limit
- Testing sequenced debris materials to produce limiting head loss
  - Particulates, fibers and chemical precipitates were introduced in non-prototypic manner to bound worst case conditions

Downstream Effects Conservatism

- Test limit established based on worst case fiber to particulate ratio
  - Lower head loss → higher debris limit would result from expected particulate/fiber ratio
- Testing ignored disruptive flow behavior present in heated core bundles
  - Local flow blockages from fiber will lead to local boiling that will act to disrupt the blockage and reestablish cooling flow



- Testing ignores alternate flow paths present in every PWR
  - Alternate flow paths will provide cooling flow to the core even if the core inlet is blocked
- Testing evaluates debris conditions under collapsed temporal conditions (i.e., Liming conditions early in event, combined with limiting conditions late in event)
  - Testing under expected conditions would likely demonstrate no adverse flow blockage for any PWR

Conservatisms in In-vessel Debris Testing

- By letter dated July 20, 2012, Pressurized Water Reactor Owners Group (PWROG) submitted a supplement to topical report documenting the conservatisms associated with the in-vessel debris testing (WCAP-16793)
- The purpose of the supplement was to facilitate future operability determinations pursuant to emergent conditions for the low fiber plants
- NRC staff elected not to include the supplement in their review of WCAP-16793
- NRC acknowledgement of the conservatisms would have strengthened the position of a low fiber plant pursuing Option 1 of SECY 12-0093 as their means of closure

Attachment 3

Examples of Plant Modifications

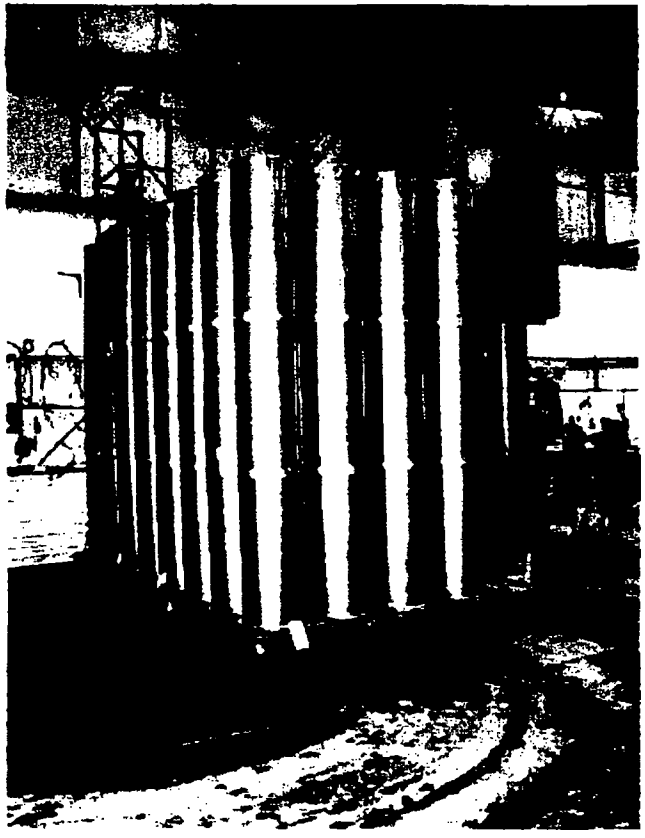
Salem Strainers

Old Strainer (85 ft^2)

New Strainer (4800 ft^2)

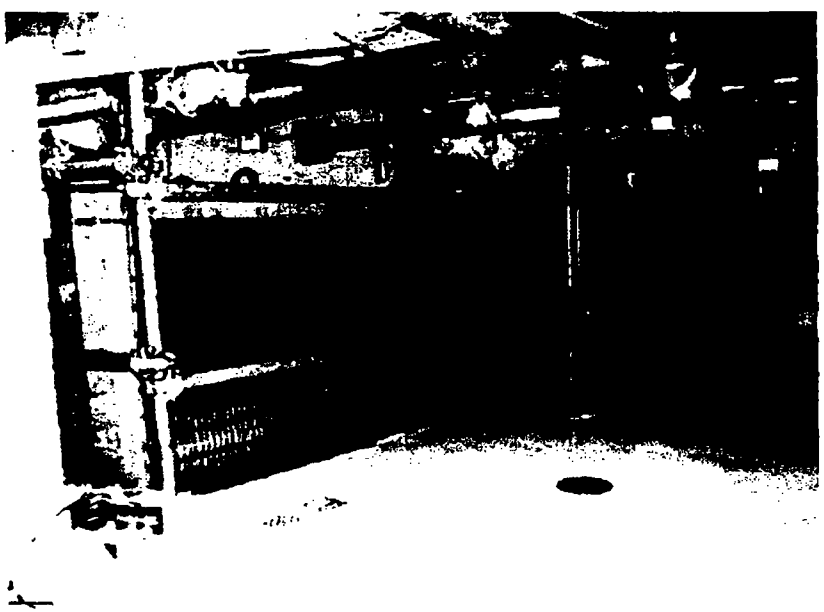
Crystal River Strainers

Strainer size increased from 86 ft^2 to 1139 ft^2

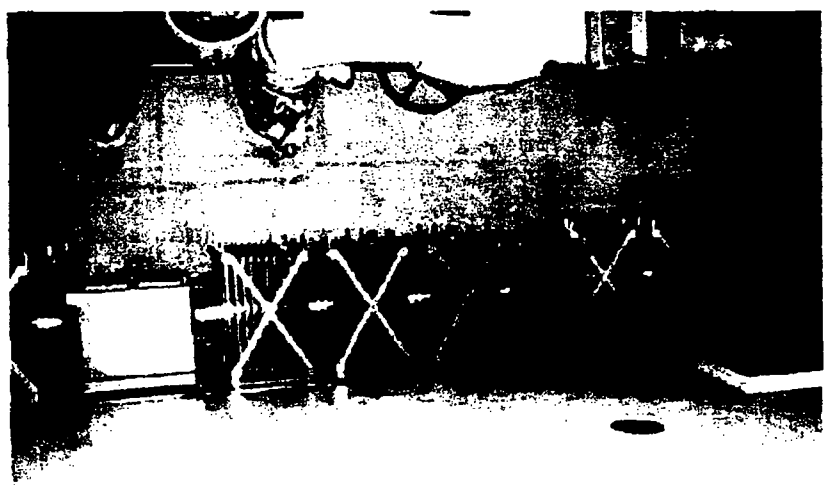


South Texas Strainer

Old Strainer (155 ft^2 per train)

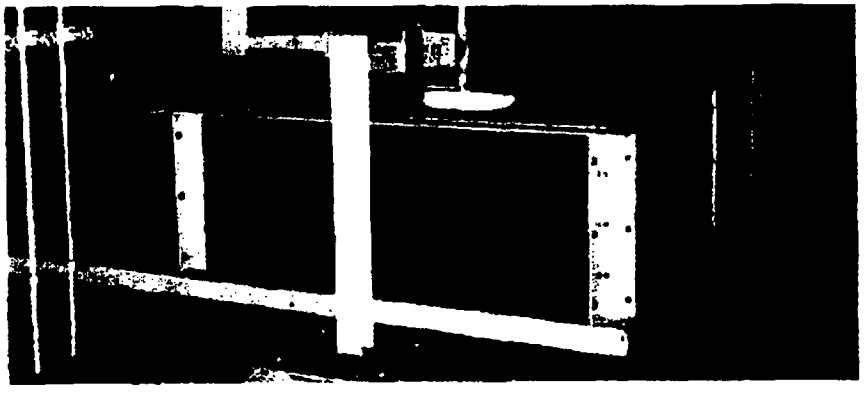


New Strainer (1819 ft^2 per train)



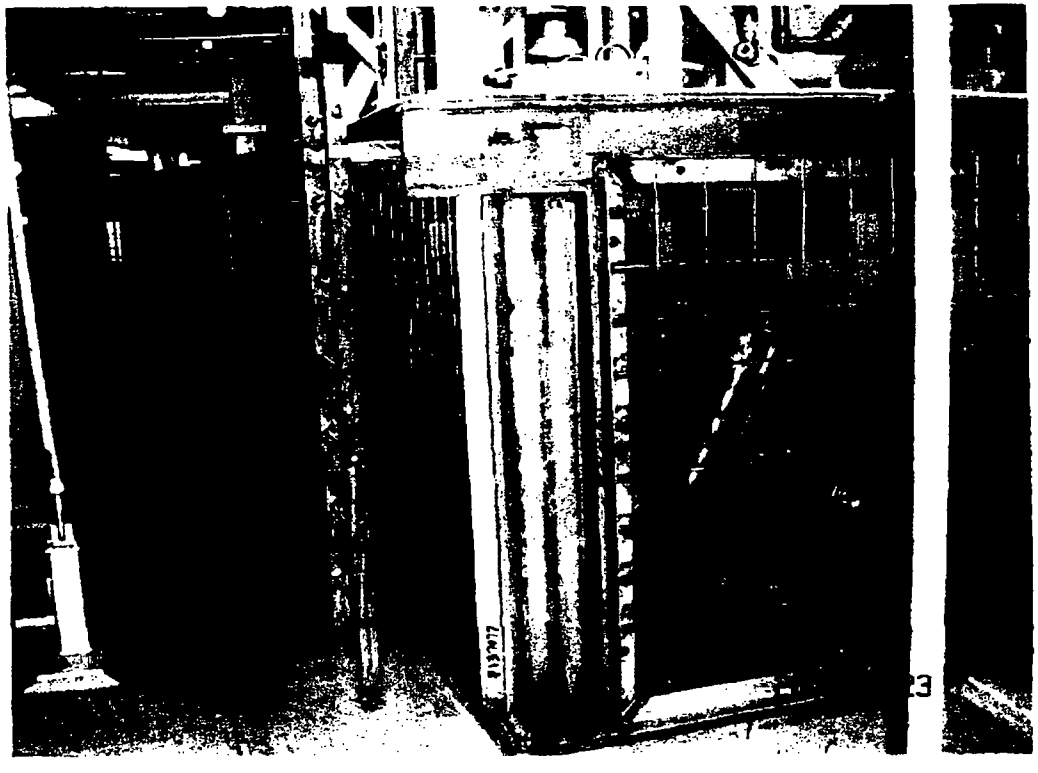
San Onofre Strainer

Old Strainer (75 ft^2 per train)



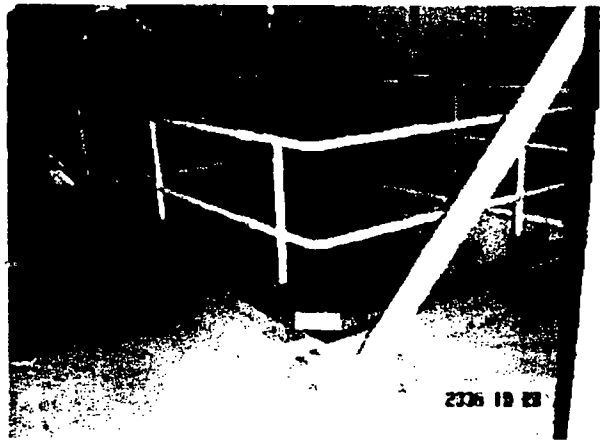
New Strainer (975 ft^2 per train)

Comanche Peak Strainer



Comanche Peak Mods to Impact Debris Transport

Open doors to move debris to inactive zones

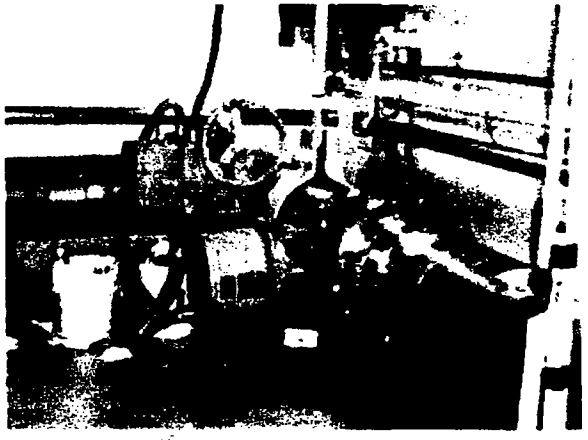


Toe Plates to drain floor but catch debris

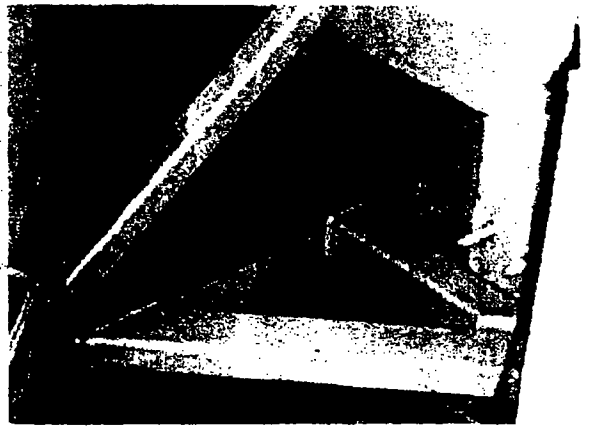
Flashing over floor gaps

Strainers installed in Cavity Drain

Comanche Peak Mods to Improve Water Movement



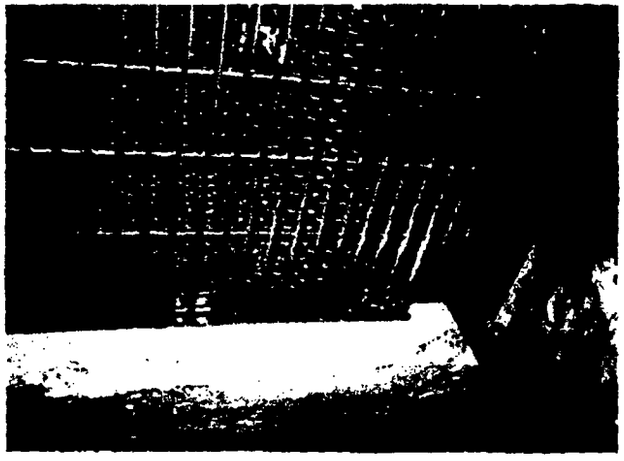
Flashing over box beams to minimize water capture



Valve replacement to increase useable water level in containment

Hood over cooling vent to prevent spray water capture

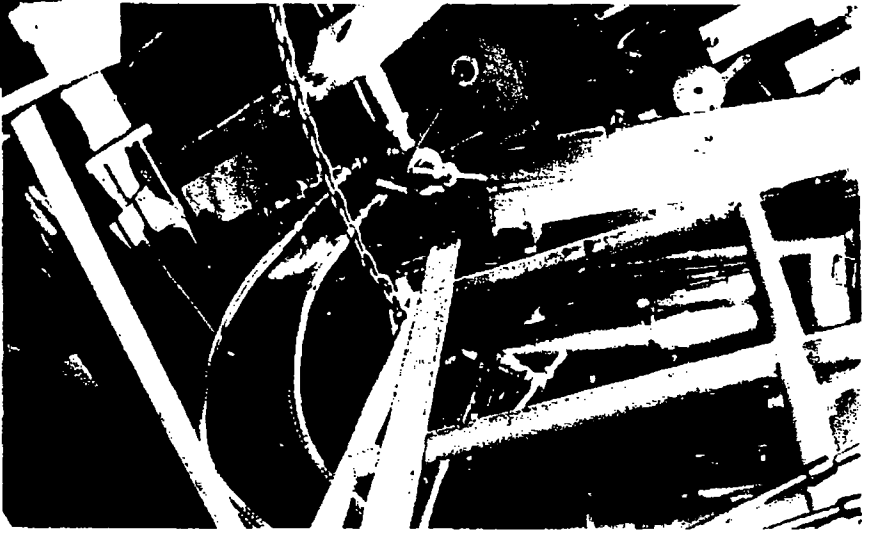
Turkey Point Mods to Impact Debris Transport



Point Beach Mods to Impact Debris Transport

Beaver Valley Insulation Replacement

Replacement of fibrous insulation with reflective metal insulation on piping

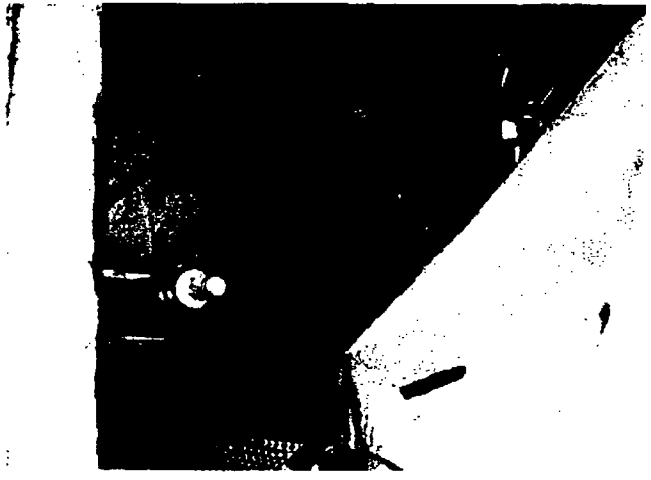


Replacement of fibrous insulation with reflective metal insulation on Steam Generator

Beaver Valley Insulation Replacement

Pre-planning and measurement are essential for effort involving tight quarters in a radiation environment

Assembly and disassembly of scaffolding are necessary, time-consuming steps



Castleman, Patrick

From: BUTLER, John [jcb@nei.org]
Sent: Thursday, October 11, 2012 2:43 PM
To: Castleman, Patrick; Gilles, Nanette; Tadesse, Rebecca; Franovich, Mike
Subject: FW: Industry GSI-191 Presentation Materials, October 9, 2012
Attachments: Industry Actions and Response to GSI-191.pdf; Industry Actions and Response to GSI-191 Attachments.pdf

Pat/Nan/Rebecca/Mike

Earlier this week we dropped in on Chairman Macfarlane to discuss GSI-191. Attached, for your information, are the materials used during this discussion. It is very similar to the materials used in the September 12-13 drop-ins with Commissioners Magwood, Apostolakis, Svinicki and Ostendorff. Changes of note are the addition of a historical timeline of GSI-191 activities, an expansion on the discussion of conservatism used in various phases of the analysis and the addition of photos illustrating some of the changes that have been incorporated into plant designs.

Please contact me if you have any questions on this material or if I can assist you in any other way.

John

John C. Butler
Senior Director, Engineering and Operations Support

Nuclear Energy Institute
1776 I Street NW, Suite 400
Washington, DC 20006
www.nei.org

P: 202-739-8108
F: 202-533-0113
M: (b)(6)
E: jcb@nei.org

nuclear. clean air energy.

From: BUTLER, John
Sent: Wednesday, October 10, 2012 5:47 PM
To: mike.franovich@nrc.gov
Subject: Industry GSI-191 Presentation Materials, October 9, 2012

Mike,

Attached, for your information, are the materials used during yesterday's drop in with the Chairman. Can you reply back with the email addresses for Reactor TAs that you believe would have an interest in receiving this.

John

John C. Butler
Senior Director, Engineering and Operations Support

Nuclear Energy Institute

1776 I Street NW, Suite 400
Washington, DC 20006
www.nei.org

P: 202-739-8108
F: 202-533-0113
M: (b)(6)
E: jcb@nei.org

nuclear. clean air energy.

nuclear

FOLLOW US ON

Kock, Andrea

From: PHELPS, Suzanne [srp@nei.org]
Sent: Monday, October 29, 2012 10:18 AM
To: Kock, Andrea
Cc: REDMOND, Everett
Subject: NEI Nuclear Fuel Supply Forum Information
Attachments: 12FS Final Parts List 080212.doc; Final Agenda.doc

Andrea,

In response to your questions to Everett Redmond regarding the NEI Nuclear Fuel Supply Forum meeting, we typically have around 150 participants from all sectors of fuel supply. I have attached the final attendees list from our July 31, 2012 meeting for your information. The agenda for the January meeting is in the very early stages of development, but we hope to have a speaker from the Department of State , possibly Thomas Countryman, to review the status of agreements for cooperation, a speaker to address implications of the elections on the industry, speakers from DOE and DOC, and several industry speakers. The agenda from last July's meeting is also attached to illustrate a typical format.

I hope this is helpful. Please let me know if you have any further questions.

Sincerely,

Suzanne R. Phelps
Senior Project Manager, Fuel Cycle Policy and Programs

NUCLEAR ENERGY INSTITUTE
1776 I Street NW, Suite 400
Washington, DC 20006
www.nei.org

P: *202-739-8119*
F: *202-533-0181*
M: (b)(6)
E: srp@nei.org

Participants List

Nuclear Fuel Supply Forum

The Westin Georgetown
Washington, D.C.
July 31, 2012

MaryBeth Andrade
Supply Chain Manager
Arizona Public Service Company
phone: (623) 393-5176
e-mail: marybeth.andrade@aps.com

Joshua Andrews
Nuclear Engineer, Nuclear Fuel Services
Southern Nuclear Operating Company
phone: (205) 992-5469
e-mail: joandrew@southernco.com

Olanrewaju Asehinde
Engineer, Nuclear Fuels
Entergy Services, Inc.
phone: (601) 368-5746
e-mail: oasehin@entergy.com

Sahar Aubon
Uranium Marketing and Trading
Traxys
phone: (212) 918-8064
e-mail: sahar.aubon@traxys.com

Harrison Barker
Manager, Nuclear Fuel Procurement
Dominion Generation
phone: (804) 273-3438
e-mail: hink.barker@dom.com

Philip Benavides
Principal Engineer
Constellation Energy Nuclear Group, LLC
phone: (410) 470-3475
e-mail: philip.benavides@cengllc.com

David Berklite
Director, Business Development
NUKEM, Inc.
phone: (203) 778-9420
e-mail: dberklite@nukeminc.com

Clark Beyer
Managing Director
Rio Tinto Uranium Ltd.
phone: +442077811379
e-mail: clark.beyer@riotinto.com

Jerome Bonnet
Vice President
UG USA Inc
phone: (301) 841-1636
e-mail: jerome.bonnet@areva.com

Adam Borcz
Sales Executive
USEC Inc.
phone: (301)219-3448
e-mail: borcza@usec.com

Timothy Breslin
Senior Engineer
Duke Energy Corporation
phone: (704) 382-5329
e-mail: Tim.Breslin@duke-energy.com

Dana Brown
Manager, North America Mining
and Front End Sales
AREVA
phone: (301) 841-1665
e-mail: dana.brown@areva.com

Larry Camper
Division Director, Regulatory Affairs
U.S. Nuclear Regulatory Commission
phone: (301) 415-7319
e-mail: larry.camper@nrc.gov

Thomas Cannon
Section Leader, Reload Analysis
Arizona Public Service Company
phone: (623) 393-5927
e-mail: thomas.cannon@aps.com

* Speaker

Philip Chaffee
Assistant Editor, Nuclear Intelligence Weekly
Energy Intelligence
phone: +4420775182212
e-mail: pchaffee@energyintel.com

Kenneth Church
Acting Manager, Fuel Management and Design
Duke Energy Corporation
phone: (704) 382-6783
e-mail: kenny.church@duke-energy.com

Bryan Corder
Trader
ITOCHU Corporation
phone: (202) 861-2240
e-mail: bryan.corder@itochu.com

James Cornell
Director, Structured Uranium Transactions
Traxys
phone: (212) 918-8000
e-mail: jcornell@traxys.com

John Creasy
Program Manager
Y-12 National Security Complex
phone: (865) 576-2728
e-mail: jcr@y12.doe.gov

David Culp
Manager, Fuel Management and Design
Duke Energy Corporation
phone: (704) 382-8833
e-mail: david.culp@duke-energy.com

Michael Culpepper
Nuclear Energy Analyst
TradeTech
phone: (704) 574-0009
e-mail: mike.culpepper@tradetech.com

Gary Darter
Director, Program Management
Nuclear Fuel Services, Inc.
phone: (423) 791-2606
e-mail: gldarter@nuclearfuelservices.com

Sashi Davies
Extract Resources UK Ltd
phone: +442073179220
e-mail: sdavies@extractresources.com

Jason Dever
Manager, North America Mining
and Front End Sales
AREVA
phone: (434) 832-2653
e-mail: jason.dever@areva.com

James Dobchuk
President
Cameco Inc.
phone: (952) 942-2470
e-mail: james_dobchuk@cameco.com

John Donelson
Vice President, Marketing, Sales and Power
USEC Inc.
phone: (301) 564-3402
e-mail: donelsonj@usec.com

Daniel Einbund
Vice President
New York Nuclear Corporation
phone: (212) 682-5070
e-mail: de@nynco.com

Gordon Epstein
Manager
Mitsubishi International Corporation
phone: (202) 331-7305
e-mail: gordon.epstein@mitsubishicorp.com

Scott Ferguson
Administrator, Fuel Supply
Wolf Creek Nuclear Operating Corporation
phone: (620) 364-4039
e-mail: scfergu@wcnoc.com

Alex Flint
Senior Vice President, Governmental Affairs
Nuclear Energy Institute
phone: (202) 739-8088
e-mail: af@nei.org

Brian Frame
Vice President, Special Projects
NUKEM, Inc.
phone: (203) 778-9420
e-mail: bframe@nukeminc.com

Christopher Frankland
Vice President, Marketing and Sales
ConverDyn
phone: (303) 930-4955
e-mail: chris.frankland@converdyn.com

Takeshi Fujii
General Manager, Deputy Representative
The Federation of Electric Power Companies
of Japan
phone: (202) 466-6781
e-mail: fujii@denjiren.com

Timothy Gabruch
Vice President, Marketing
Cameco Corporation
phone: (306) 956-6284
e-mail: tim_gabruch@cameco.com

Dustin Garrow
Executive General Manager, Marketing
Paladin Energy Ltd
phone: (303) 973-9480
e-mail: dustin.garrow@paladinenergy.com.au

Ellen Ginsberg
Vice President, General Counsel
and Secretary
Nuclear Energy Institute
phone: (202) 739-8140
e-mail: ecg@nei.org

James Glasgow
Partner
Pillsbury Winthrop Shaw Pittman LLP
phone: (202) 663-9200
e-mail: james.glasgow@pillsburylaw.com

Michael Goldenberg
Director, Nuclear Fuels
Evolution Markets, Inc.
phone: (914) 323-0252
e-mail: mgoldenberg@evomarkets.com

William Goranson
President
Cameco Resources
phone: (307) 316-7602
e-mail: paul_goranson@cameco.com

Frank Hahne
Director, Business Development
B&W Technical Services Group, Inc.
phone: (434) 522-6000
e-mail: fjhahne@babcock.com

Bruce Hamilton
President
Fuelco LLC.
phone: (214) 789-9076
e-mail: bruce.hamilton@fuelcollc.com

Bruce Hanni
Director, Business Services
Fluor-B&W Portsmouth LLC
phone: (509) 528-6485
e-mail: bruce.hanni@fluor.com

Robert Hard
Market Analyst
NUKEM, Inc.
phone: (203) 778-9420
e-mail: rhard@nukeminc.com

Gary Harki
Reporter
Energy Intelligence Weekly
phone: (202) 662-0706
e-mail: gharki@energyintel.com

Tracy Heidelberg
Chief Financial Officer
Fluor-B&W Portsmouth LLC
phone: (740) 897-3195
e-mail: tracy.heidelberg@fluor.com

Mark Herlach
Partner
Sutherland Asbill & Brennan, LLP
phone: (202) 383-0172
e-mail: mark.herlach@sutherland.com

Elaine Hiruo
Press
Platts Nuclear Publications
phone: (202) 383-2163
e-mail: elaine_hiruo@platts.com

James Hobbs
Director, Business Development
Nuclear Fuel Services, Inc.
phone: (423) 735-5482
e-mail: jshobbs@nuclearfuelservices.com

Daniel Horner
Editor
Arms Control Today
phone: (202) 463-8272 x108
e-mail: dhorner@armscontrol.org

Kevin Houston
Senior Engineer, Fuel Supply
Duke Energy Corporation
phone: (704) 382-6815
e-mail: kevin.houston@duke-energy.com

Rebecca Hovland
Nuclear Fuel Supply Engineer
Progress Energy
phone: (919) 546-6629
e-mail: rebecca.hovland@pgnmail.com

Scott Hyman
Vice-President, Marketing, Americas
Cameco Inc.
phone: (952) 942-2460
e-mail: scott_hyman@cameco.com

Randall Irwin
Vice President, Fuel Supply
Ameren Missouri
phone: (314) 554-2207
e-mail: rirwin@ameren.com

Nodra Isamiddinova
CIS Coordinator
NUKEM, Inc.
phone: (203) 778-9420
e-mail: nisamiddinova@nukeminc.com

James Israel
Vice President, Marketing, Asia
Cameco Inc.
phone: (952) 941-9078
e-mail: james_israel@cameco.com

Per Jander
Vice President, Marketing, Europe and Trading
Cameco Inc.
phone: (952) 942-2471
e-mail: per_jander@cameco.com

Andrea Jennetta
Publisher
Fuel Cycle Week
phone: (202) 577-8022
e-mail: ajennetta@innuco.com

Darrin Kahl
Manager, Supply and Asset Management
SCANA Corporation
phone: (803) 217-5312
e-mail: dkahl@scana.com

Tamaki Kanemori
Group Manager
ITOCHU International, Inc.
phone: (202) 861-1213
e-mail: tamaki.kanemori@itochu.com

Leslie Kass
Vice President, Regulatory Affairs
Westinghouse Electric Company
phone: (301) 881-7040
e-mail: kasslc@westinghouse.com

John Keeley
Media Relations Manager
Nuclear Energy Institute
phone: (202) 739-8020
e-mail: jmk@nei.org

Markus Kemmerer
Senior Trader
NUKEM, Inc.
phone: (203) 778-9420
e-mail: mkemmerer@nukeminc.com

Treva Klingbiel
President
TradeTech
phone: (303) 573-3530
e-mail: treva.klingbiel@tradetech.com

James Kollar
Nuclear Fuel Manager
Luminant/Fuelco
phone: (214) 875-8522
e-mail: James.Kollar@fuelcollc.com

Kristian Kunert
Senior Sales Executive
USEC Inc.
phone: (301) 564-3364
e-mail: kunertk@usec.com

Robert Lee
Nuclear Fuel Buyer
Exelon Generation
phone: (630) 657-2155
e-mail: robertc.lee@exeloncorp.com

Sarina Lewis
Nuclear Fuel Procurement Specialist
Dominion Generation
phone: (804) 273-2468
e-mail: sarina.e.lewis@dom.com

Eric Lewis
Manager, Nuclear Fuels Supply
Entergy Services, Inc.
phone: (601) 368-5421
e-mail: elewis5@entergy.com

Byron Little
Manager, Marketing, Americas
Cameco Inc.
phone: (952) 942-2463
e-mail: byron_little@cameco.com

R. Scott Lumadue
Director, Marketing- Americas
Uranium One
phone: (303) 325-2386
e-mail: scott.lumadue@uranium1.com

Ganpat Mani
President and Chief Executive Officer
ConverDyn
phone: (303) 930-4901
e-mail: ganpat.mani@converdyn.com

Mick Mastilovic
Manager, Nuclear Fuel Supply
Tennessee Valley Authority
phone: (423) 751-2350
e-mail: pmastilovic@tva.gov

Bouphavanh Mathouravong
Advanced Nuclear Specialist
FirstEnergy Corp.
phone: (330) 315-6815
e-mail: bmathouravong@firstenergycorp.com

Andrew Mauer
Senior Project Manager, Fuel
and Materials Safety
Nuclear Energy Institute
phone: (202) 739-8018
e-mail: anm@nei.org

Joseph McCourt
President
New York Nuclear Corporation
phone: (212) 682-5070
e-mail: jm@uranium.com

Timothy McGraw
Executive Vice President
NUKEM, Inc.
phone: (203) 778-9420
e-mail: tmcgraw@nukeminc.com

John McGuire
Manager, North America Mining
and Front End Sales
AREVA
phone: (301) 841-1650
e-mail: john.mcguire@areva.com

Thomas Meade
Vice President
Energy Resources International, Inc.
phone: (202) 785-8833
e-mail: meade@energyresources.com

Scott Melbye
Executive Vice President, Marketing
Uranium One
phone: (303) 325-0129
e-mail: scott.melbye@uranium1.com

David Mienke
Senior Project Manager, Nuclear Fuel Supply
Xcel Energy
phone: (612) 330-6794
e-mail: david.mienke@xenuclear.com

Burke Moeller
Owner and Publisher
EnergyMole.com
phone: (703) 732-5158
e-mail: burke@energymole.com

Richard Myers
Vice President, Policy Development, Planning
and Supplier Program
Nuclear Energy Institute
phone: (202) 739-8021
e-mail: rjm@nei.org

Stephen Nance
STP Nuclear Operating Company
phone: (361) 972-8180
e-mail: swnance@stpegs.com

Teppei Narita
Vice President, Nuclear Fuel
Energy U.S.A., Inc.
phone: (203) 791-2222 x200
e-mail: narita@energyusainc.com

Valeria Nazimova
Director, Marketing Department
Techsnabexport (TENEX)
phone: +74955450045 x2009
e-mail: nazimovav@tenex.ru

Ruthanne Neely
Senior Vice President, Enrichment
and General Counsel
The Ux Consulting Company, LLC
phone: (301) 941-1975
e-mail: ruthanne.neely@uxc.com

Fletcher Newton
Consultant
New World Consulting LLC
phone: (720) 280-8020
e-mail: f.newton@mwc-llc.com

Hannah Northey
Reporter
E & E Publishing, LLC
phone: (202) 446-0468
e-mail: hnorthey@eenews.net

Shuichi Ohashi
President and Chief Executive Officer
Energy U.S.A., Inc.
phone: (202) 785-9260
e-mail: ohashi@energyusainc.com

Jim Ostroff
Senior Editor
Platts Nuclear Publications
phone: (202) 383-2249
e-mail: james_ostroff@platts.com

David Overton
Supervisor, Fuel Planning and Performance
FirstEnergy Corp.
phone: (330) 315-6852
e-mail: overtond@firstenergycorp.com

Frederic Patreau
Vice President, Sales Coordination
North America Mining and Front End Sales
AREVA
phone: (301) 841-1769
e-mail: frederic.patreau@areva.com

Suzanne Phelps
Senior Project Manager, Fuel Cycle Policy
and Programs
Nuclear Energy Institute
phone: (202) 739-8119
e-mail: srp@nei.org

Mary Pietrzyk
Manager, Fuel Cycle Policy and Programs
Nuclear Energy Institute
phone: (202) 739-8142
e-mail: mmp@nei.org

F.P. Powell
Vice President of Marketing and Sales
Uranium Energy Corp
phone: (561) 972-1591
e-mail: bpowell@uraniumenergy.com

Scott Praetorius
Program Manager Nuclear Fuels Procurement
Energy Northwest
phone: (509) 377-4325
e-mail: smpraetorius@energy-northwest.com

Christopher Pugsley
Partner
Thompson & Pugsley, PLLC
phone: (202) 496-0780
e-mail: cpugsley@athompsonlaw.com

Penny Quinn
Director, Fleet Nuclear Fuels
Constellation Energy Nuclear Group, LLC
phone: (410) 470-3767
e-mail: penny.quinn@cengllc.com

Stephen Rademaker
Principal
Podesta Group
phone: (202) 448-5238
e-mail: srademaker@podesta.com

Everett Redmond II
Senior Director, Non-Proliferation
and Fuel Cycle Policy
Nuclear Energy Institute
phone: (202) 739-8122
e-mail: elr@nei.org

Roger Reynolds
Senior Technology Advisor
TerraPower
phone: (509) 378-5299
e-mail: rreynolds@terrapower.com

Robert Rich
U.S. and Canadian Representative
Paladin Energy Ltd
phone: (508) 240-1259
e-mail: bob.rich@paladinenergy.com.au

Sarah Riedel
Director, Marketing International
Uranium One
phone: (303) 325-2387
e-mail: sarah.riedel@uranium1.com

Scott Robertson
Sales Manager, North America Mining
and Front End Sales
AREVA
phone: (434) 832-2357
e-mail: scott.robertson@areva.com

Ross Robinson
Director, Nuclear Materials Initiative
Y-12 National Security Complex
phone: (865) 574-8509
e-mail: robinsonrc@y12.doe.gov

Enrique Rodriguez
Senior Nuclear Fuel Supply Engineer
Progress Energy
phone: (919) 546-7386
e-mail: enrique.rodriguez@pgnmail.com

Robert Rose
Nuclear Fuel Contracting Agent
PPL Susquehanna, LLC
phone: (610) 774-7993
e-mail: rmrose@pplweb.com

Christopher Rusch
Senior Consultant
NAC International
phone: (678) 328-1222
e-mail: crusch@nacintl.com

Chuck Russell
Director Business Development
TENAM Corporation
phone: (202) 730-1275
e-mail: chuck.russell@tenam-usa.com

William Sacks
Radiation Protection Division Intern
U.S. Environmental Protection Agency
phone: (401) 487-1397
e-mail: sacks.william@epa.gov

Janet Schlueter
Director, Fuels and Materials Licensees
Nuclear Energy Institute
phone: (202) 739-8098
e-mail: jrs@nei.org

David Schramm
Vice President, Marketing
Globe Nuclear Services and Supply
GNSS, Limited
phone: (301) 941-1200
e-mail: dschramm@gnss-swu.com

Mike Sherman
Assistant Director
The Ux Consulting Company, LLC
phone: (770) 642-7745
e-mail: mike.sherman@uxc.com

Tim Shirkey
Manager, Marketing Americas
Cameco Inc.
phone: (952) 942-2472
e-mail: tim_shirkey@cameco.com

Chad Sigmon
Manager, Nuclear Fuel
Energy U.S.A., Inc.
phone: (203) 791-2222 x201
e-mail: crsigmon@energyusainc.com

William Skaff
Director, Policy Analysis
Nuclear Energy Institute
phone: (202) 739-8036
e-mail: wgs@nei.org

Olga Skorlyakova
Deputy Director, Department
of Intergovernmental Programs
and Pan American Operations
Techsnabexport (TENEX)
phone: +74955450045 x2059
e-mail: skorlyakova.o.a@tenex.ru

Kevin Smith
Director, Uranium Marketing and Trading
Traxys
phone: (212) 918-8000
e-mail: kevin.smith@traxys.com

Brian Speight
Intern
TradeTech
phone: (303) 573-3530
e-mail: brian.speight@tradetech.com

Curt Steel
Vice President, Marketing and Sales
Denison Mines Corp.
phone: (203) 722-9265
e-mail: csteel@denisonmines.com

Gary Steele
Vice President, Corporate Marketing
Energy Fuels Resources Corporation
phone: (303) 974-2147
e-mail: g.steele@energyfuels.com

Julian Steyn
President Emeritus
Energy Resources International, Inc.
phone: (202) 785-8833
e-mail: steyn@energyresources.com

Masateru Sugihara
Group Manager
ITOCHU Corporation
phone: +81334976630
e-mail: sugihara-m@itochu.co.jp

Eileen Supko
Vice President
Energy Resources International, Inc.
phone: (202) 785-8833
e-mail: supko@energyresources.com

Michelle Swanson
Commercial Project Manager
Constellation Energy Nuclear Group, LLC
phone: (410) 470-3449
e-mail: michelle.swanson@cengllc.com

John Sweeter
Commercial Director
Global Nuclear Fuel
phone: (910) 819-5474
e-mail: john.sweeter@ge.com

Hugh Switzer
Manager, Corporate Development
Boswell Capital Corporation
phone: (416) 962-0080
e-mail: hswitzer@boswellcapital.com

Shuhei Tada
Manager
Mitsui & Co., Ltd.
phone: +81332853397
e-mail: Sh.Tada@mitsui.com

Tom Taylor
Vice President Sales
GE Hitachi Nuclear Energy
phone: (910) 819-6045
e-mail: thomas2.taylor@ge.com

Douglas Tisdel
Senior Nuclear Fuel Buyer
PSEG Nuclear LLC
phone: (856) 339-1538
e-mail: doug.tisdel@pseg.com

Jeanne Tortorelli-Shobert
Manager, Fleet Nuclear Fuels
Constellation Energy Nuclear Group, LLC
phone: (410) 470-3304
e-mail: jeanne.m.shobert@cengllc.com

Shinichiro Uemiya
Director, Nuclear Fuel Cycle
Toshiba America Nuclear Energy Corporation
phone: (571) 296-4341
e-mail: suemiya@tane.toshiba.com

Kendall Vasilnek
Engineer
American Electric Power
phone: (269) 697-5132
e-mail: krvasilnek@aep.com

Marisa Vilardo
Director, Sales
USEC Inc.
phone: (301) 564-3220
e-mail: vilardom@usec.com

April Wade
Uranium Resources, Inc.
phone: (703) 992-7980
e-mail: april@wadestrategic.com

Theodore Weber
Manager
ITOCHU International, Inc.
phone: (202) 822-9084
e-mail: theodore.weber@itochu.com

Staci Wheeler
Director, Legislative Programs
Nuclear Energy Institute
phone: (202) 739-8095
e-mail: saw@nei.org

Bill Whitacre
Manager, North America Mining
and Front End Sales
AREVA
phone: (301) 841-1634
e-mail: bill.whitacre@areva.com

Shawn Whitman
Principal
Kountoupes Consulting, LLC
phone: (202) 585-0277
e-mail: shawn@kcindc.com

John Williams
Supervisor, Nuclear Fuel Supply
Southern Nuclear Operating Company
phone: (205) 992-7203
e-mail: johnbwil@southernco.com

Anthony Wlezien
Nuclear Fuel Buyer
Exelon Generation Company, LLC
phone: (630) 657-2156
e-mail: anthony.wlezien@exeloncorp.com

Alice Wong
Site Vice President and Chief Corporate Officer
Cameco Corporation
phone: (306) 956-6337
e-mail: alice_wong@cameco.com

Masahiro Yamamoto
Deputy General Manager, Nuclear Fuel
Power Systems Unit
Mitsubishi Corporation
phone: +81332103742
e-mail:
masahiro.yamamoto@mitsubishicorp.com

Tsuyoshi Yoshikawa
Leader, Trading Operations
ITOCHU Corporation
phone: +81334976633
e-mail: yoshikawa-tsuyoshi@itochu.co.jp

List Dated: August 2, 2012

Agenda

Nuclear Fuel Supply Forum

Westin Georgetown
Washington, D.C.
July 31, 2012

Registration and Continental Breakfast
Washington Ballroom Foyer
8:00 – 9:00 a.m.

General Session
Washington Ballroom
9:00 a.m.–3:30 p.m.

9:00 a.m.–12:00 p.m.
Session Chair
Paul Goranson
President
Cameco Resources, Inc.

Keynote Remarks:
A View from Congress
The Honorable John Barrasso (WY)
United States Senate

Perspective on Nuclear Export Policies and Implications for the Fuel Market
Stephen Rademaker
Principal
The Podesta Group

NEI Fuel Cycle Activities and Blue Ribbon Commission Recommendation Implementation
Everett Redmond
Senior Director, Nonproliferation and Fuel Cycle Policy
Nuclear Energy Institute

U.S. Government Policy and Domestic Uranium Production
Scott Melbye
Executive *Vice President, Marketing*
Uranium One

Ganpat Mani
President and Chief Executive Officer
ConverDyn

Legislative Priorities and Initiatives
Alex Flint
Senior Vice President, Governmental Affairs
Nuclear Energy Institute

Lunch
The Promenade
12:00–1:30 p.m.

General Session
Washington Ballroom
1:30 – 3:30 p.m.
Session Chair
Penny Quinn
Director, Fleet Nuclear Fuels
Constellation Energy Nuclear Group, LLC

NRC Regulatory Impact on Fuel Fabrication
Leslie Kass
Vice President, Regulatory Affairs
Westinghouse Electric Company

NRC Regulations for Fuel Facilities
Larry Camper
Division Director, Uranium Recovery
U.S. Nuclear Regulatory Commission

Industry Perspective on Domestic Uranium Supply
Christopher Pugsley
Partner
Thompson and Pugsley, PLLC

Fuel Litigation Overview
Ellen Ginsberg
General Counsel
Nuclear Energy Institute

Summary and Adjournment
Penny Quinn
Director, Fleet Nuclear Fuels
Constellation Energy Nuclear Group, LLC

Reception
The Promenade
4–5:30 p.m.